Heating Piping & Air Conditioning

DECEMBER 1959

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. . . for Consulting Engineers • Mechanical (Heating, Piping, and Air Conditioning) Contractors • Engineers with Plants and Big Buildings

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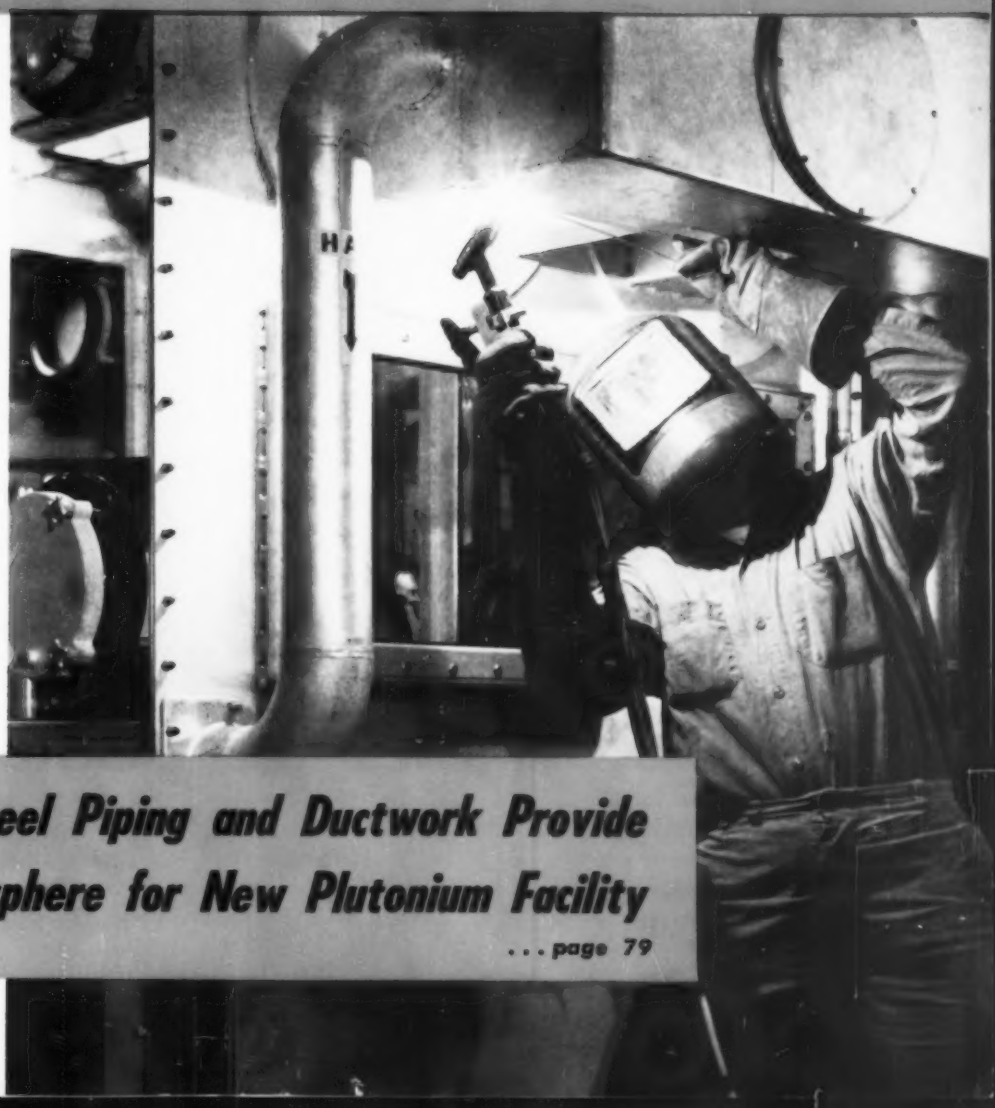

Stainless Steel Piping and Ductwork Provide Inert Atmosphere for New Plutonium Facility

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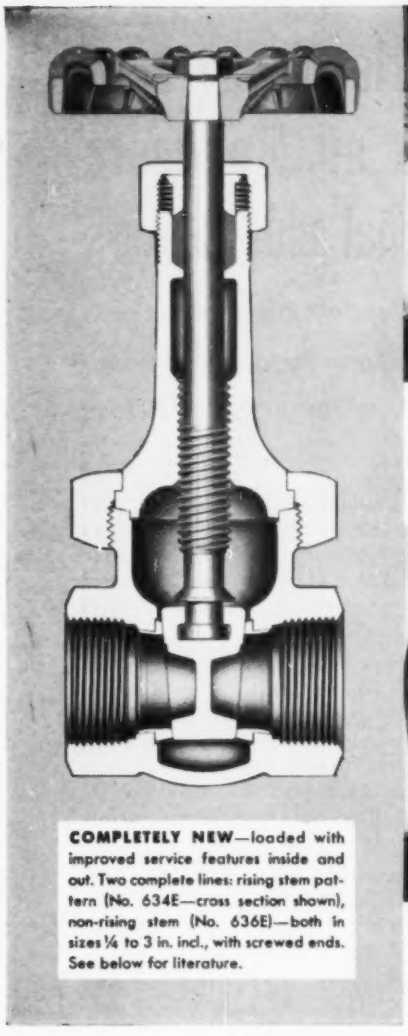
"Emeralds by Cartier"

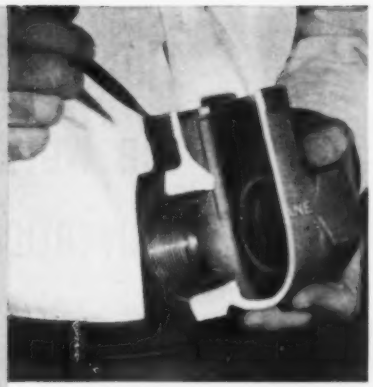
EXCITING THINGS ARE HAPPENING IN WORTHINGTON PACKAGE LIQUID CHILLERS

Why is it that superior engineering always produces a smaller package? This Worthington package liquid chiller requires considerably less headroom and floor space than competitive units, saving money on space and installation. This chiller is shipped completely assembled, requiring only power and water connections. In sizes from 15 to 250 tons. Every way you look at it, it's a jewel of great value. Worthington Corporation, Ampere Station, East Orange, New Jersey. In Canada: Worthington (Canada) Ltd., Brantford, Ontario. 12-24

WORTHINGTON

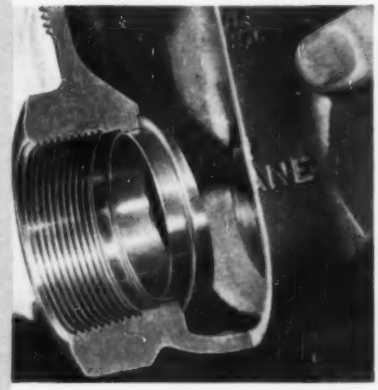


COMPLETELY NEW—loaded with improved service features inside and out. Two complete lines: rising stem pattern (No. 634E—cross section shown), non-rising stem (No. 636E)—both in sizes ¼ to 3 in. incl., with screwed ends. See below for literature.



NEW CYLINDRICAL BODY SHAPE—a proven design on high-pressure steel valves—increases strength without added bulk, distributes pressure load uniformly, resists distortion and leakage at seats.

NEW, STRONGER HEX ENDS, better integrated with body, eliminate sharp contours, give entire valve more rigidity under line strains. Wider hex faces allow firmer wrench grip for easier installation. Marring less likely.



NEW, EXPANDED-TYPE BODY RINGS insure long, tight-seating service life. They're rolled in, can't work loose. Shoulder at bottom of end threads restrains excessive entry of pipe against possible seat damage.

NEW EXELLOY, 12% chromium steel body rings give a hard bearing surface, highly resistant to wear, indentation, scoring and foreign matter damage. Easily replaced bronze disc takes the brunt of normal wear.

New design for tough service...easy maintenance

300-Pound Wedge Disc Bronze Gate Valves

Rising Stem and Non-Rising Stem Patterns

A new body shape that distributes greater strength uniformly against internal stresses and external strains . . . better integrated hex ends, huskier and wider, that add to body rigidity and give a firmer wrench grip . . . new rolled-in, high wear-resisting alloy body rings that don't work loose . . . easily renewed wedge disc—these are typical important features of new Crane bronze gate valves.

On your toughest services, these valves assure ultimate durability . . . new ease of application . . . low-cost repairability. And they're priced no higher than ordinary 300-pound integral seat bronze valves.

Easy to Repair—The Disc Takes the Wear

After long, hard service the hard Exelloy (12% chromium) body rings show no appreciable wear. Normal seating wear is taken by the bronze disc. When needed, a new disc, easily slipped onto stem, provides a practically new, tight-seating valve.

Circular Gives The Facts

For complete technical data on both rising stem and non-rising stem patterns . . . size listing, etc., get Circular AD-2340 from your Crane Representative, or by writing to address below.

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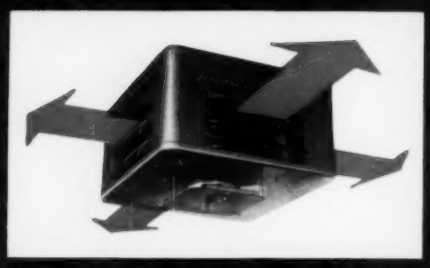
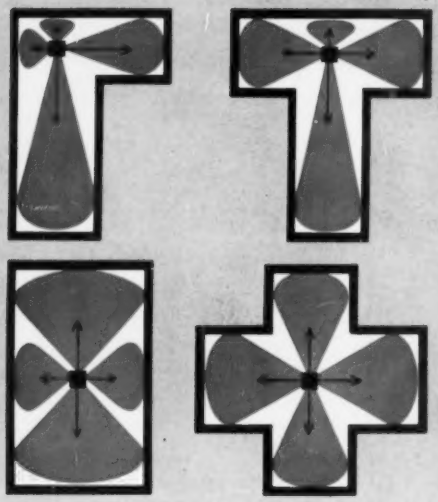


Carrier "Clover Leaf" Unit Heaters, for steam or hot water, come in eight sizes, ranging from 55,000 to 600,000 Btu/hr.

This Carrier 4-way does the work of 2 or more conventional unit heaters

save your client's money when you modernize heating systems or specify new heaters for plant additions



Adjustable louvers can shape "Clover Leaf's" air distribution pattern to heat any shape area.

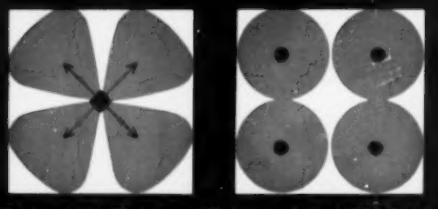
Whether your client is building a new plant or modernizing an existing one, you can save him money on his heating system by specifying Carrier's "Clover Leaf" Unit Heater. One of these versatile heaters does the job of two or more vertical discharge heaters —or four to six horizontal heaters.

The reason for this unusual performance lies in the "Clover Leaf's" unique method of air distribution. It gives greater heating coverage by discharging heated air in as many as four directions at one time. Using all four of its outlets, the largest of these Carrier units can heat a room 104 feet square. Or blowing air in two directions it can heat a narrow building 136 feet long!

Adjustable louvers make it easy to vary the shape of the "Clover Leaf's" air distribution pattern. Without changing outlets or adding accessories it can heat L, T, I or square shaped buildings.

Because of its greater heating coverage you need fewer "Clover Leaf" heaters to do a heating job. That means more than just lower first cost. It also means a lower installation cost, lower operating and maintenance cost—lower costs right down the line.

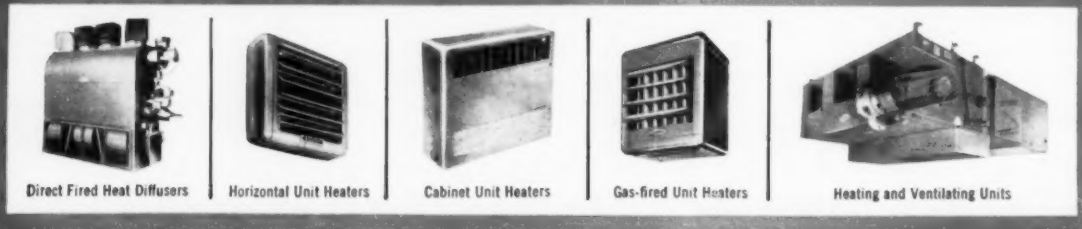
For complete information about the "Clover Leaf" Unit Heater call your Carrier representative listed in your Classified Telephone Directory under "Heaters—Unit." Or write Carrier Corporation, Unit Heater Department, Syracuse, N. Y.



One large "Clover Leaf" can heat this 100-foot-square room. It takes four vertical discharge heaters with same capacity to do this same job.

Carrier

industrial heating · air conditioning · refrigeration



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Heating Piping & Air Conditioning

Vol. 31, No. 12

(With which is merged the Aerologist)

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Here are the steam traps designed especially for heating systems . . .

ARMSTRONG OPEN FLOAT AND THERMOSTATIC STEAM TRAPS

Engineered for low pressure intermittent service where large amounts of air accumulate while steam is off

Armstrong O.F.&T. Traps make it possible for heating systems to deliver the efficiency they were designed to deliver. They are ideal for low pressure unit heaters, preheat and reheat coils, converters, hot water generators, etc.

Advantages to the user:

BIG AIR HANDLING CAPACITY—Thermic vent handles large amounts of air in system when steam is turned on. Fixed vent handles normal air in system.

NO STEAM LOSS—Stainless steel valve is water sealed, is not damaged by dirt or scale, cannot develop steam leaks.

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LONG LIFE—All working parts, including open float, are stainless steel. Bodies and caps designed for 250 psig operation. Open float cannot collapse.

MINIMUM MAINTENANCE—Simple, proved design and high quality materials assure trouble-free service.

Advantages to the contractor:

LOW COST—Mass production methods permit high quality at low cost.

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MINIMUM CALL-BACKS—Nothing to stick or clog. Unaffected by ordinary dirt.

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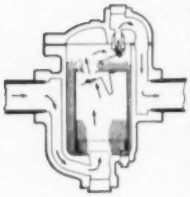
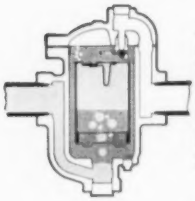
HOW ARMSTRONG O. F. & T. TRAPS WORK:



When steam is turned on, it pushes air through the wide open thermic vent and trap discharge valve at full differential pressure between supply and return lines. Condensate formed by incoming steam goes right through.



As steam reaches open float, thermostatic vent closes. Float fills with steam and rises to close trap valve. Residual air and CO_2 escape through fixed vent at steam temperature.

BULLETIN NO. 775 BULLETIN NO. 801

Use the coupon at right to get these helpful bulletins: No. 775 describes O.F.&T. traps fully. No. 801 tells how to select traps for draining unit heaters including data on 30 makes of unit heaters.

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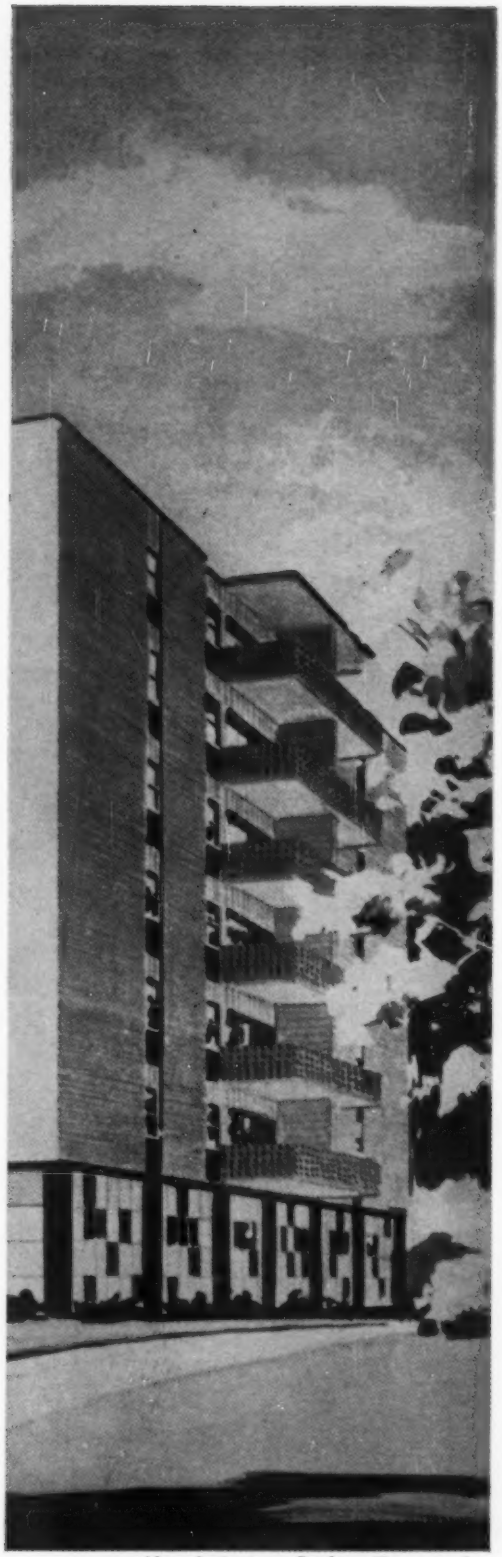

Akron's 7-story Carlton House to be cooled with individual Arkla-Servel units

Harry Sugar (left), one of the builders, and designer Matthew J. Rosenstock

Individual GAS *units to cool and heat new $2 million apartment house*

Akron's luxurious Carlton House will mark the largest use of individual gas air conditioning units in a single apartment house.

Summer cooling and winter heating will be provided for the suites by 58 three-and-a-half and five ton Arkla-Servel Sun Valley gas air conditioners.

The Arkla-Servel gas air conditioning units were chosen after serious consideration of all types available. The designer insisted that each apartment have individual thermostat control as well as individual installations to eliminate the need for large compressors and any possible vibration. Because gas is also used for cooking as well as heating and cooling, there was no need for installing heavy cable, either.

The Arkla units will be installed in the utility rooms of each suite. Four small water towers, located on the roof, will provide condensing water for the system. The water will be constantly recirculated, thus keeping its cost at a minimum.

Check the facts and you too will see that modern Gas air conditioning out-performs all others. For specific details call your local Gas Company's air conditioning specialist, or write to the Arkla Air Conditioning Corporation, General Sales Office, 812 Main Street, Little Rock, Ark. *American Gas Association*

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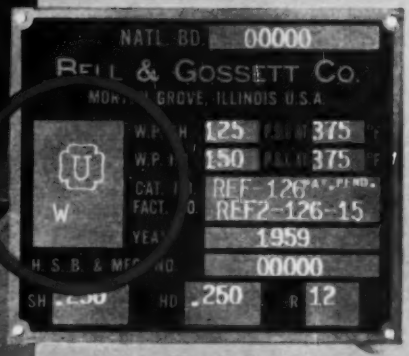

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All facilities required for heat exchanger manufacture are available under one roof at B&G, where assembly line procedures permit building an inventory of stock items. Many of the machining, tooling and welding fixtures are especially designed by B&G. All welding procedures must satisfy A.S.M.E. standards...and all welding is spot X-rayed.

B&G Heat Exchangers are manufactured by methods which hold shell diameters exact and free of distortion. This permits tight fitting baffles with minimum liquid slippage and easy replacement of tube bundles if ever necessary.

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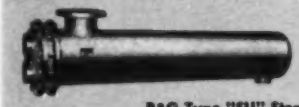

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B&G Heat Exchangers are welded in specially designed fixtures by expert workmen.

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LETTER FROM THE EDITOR

December 1959

Dear Reader:

Many new techniques were used in the design and installation of the stainless steel piping and ducts for the new plutonium fabrication facility at Argonne National Laboratory near Chicago. The inert gas used in this new laboratory is helium, and it was chosen because the plutonium is highly toxic, radioactive, and pyrophoric. The helium atmosphere is provided in enclosed working chambers. Two separate stainless steel piping circuits are used -- one is for recirculating either 1000 or 2000 cfm of helium and the other is for regenerating and purifying 100 cfm of helium constantly. The article is presented on pages 79-83.

Apartment air conditioning is increasing all the time, and it was included in the early planning for the new Benson-East luxury apartment-hotel-office building near Philadelphia. Because of the wide range of comfort systems to satisfy the many different types of occupancy, considerable study was devoted to the problem. Finally, it was decided that fan-coil units should be used in the apartments, offices, and commercial areas as they would provide the desired flexibility in room arrangements. George A. Innes, consulting engineer who made this analysis, discusses the design features of this system in his article on pages 84-86.

The conventional or manual method for calculating piping stresses for high temperature systems requires many hours, even days. The need for a shorter method to speed up the laborious task was obvious to H. B. Ellis and his associates. Their solution led to the use of the Bendix G-15D, a small and relatively low cost computer. Mr. Ellis explains the procedure to be followed in his article that begins on page 87.

The new sheet metal duct manual as highlighted by James H. Stiggleman in his article on pages 92 to 95 is certainly a worthwhile tool for engineers and contractors alike. Based upon the tremendous response received after the first article about this new manual was published in our November issue, it will soon have wide use. This second article by Mr. Stiggleman outlines several special features in the new manual such as duct hangers, access doors, etc.

How the University of Chicago has been able to achieve continued low steam consumption as the number of buildings has been increased is explained by Lyman R. Flook in his article on pages 96-99. He points out that this has been accomplished through a well organized program in which the need for conservation of steam has been stressed to obtain cooperation of the users in each building. Mr. Flook explains how this program works and what steam metering and billing procedures are used. During the past 30 years the factor "X" has been used as an index to indicate excessive use or waste of steam so that any trouble can be found in the system. By preheating the buildings or parts of some buildings well in advance of the morning peakload, the maximum hourly steam delivered to the tunnel mains by the boilers was very much reduced. As Mr. Flook says, this heating plant has been an excellent training ground from which many dedicated men have graduated to serve others and apply these sound operating principles.

The practical advice of Lester T. Avery in his article this month (page 100) is worth noting. He reviews his experiences with evaporative condensers and cooling towers and how improper operation can cause compressor problems. Some of his tricks to keep the liquid line from boiling should be remembered.

Central air conditioning can cut shopping center cooling costs, according to Herman Guttman in his remarks before the recent Air-Conditioning and Refrigeration Institute conference in Atlantic City. He cited the Southdale Shopping Center in Minneapolis as an example of what should be done. The article containing Mr. Guttman's analysis of this central air conditioning plant is on pages 103 and 104.

The design of piping systems for skating rinks is becoming more and more a factor these days as the number of rinks increase. The Baltimore Municipal Rink is an interesting installation as the concrete slab serves as a parking lot when it is not used as a rink. William J. O'Mahony explains his design approach and outlines the installation techniques used for this system. He gives much practical information about his firm's procedures in designing these piping systems in his article on pages 106 and 107.

Designing the heating and ventilating systems for the modern high school campus with separate buildings requires an engineering analysis all the way. Such an installation where many different methods are used is explained by William B. Koerner in his article on pages 108 to 110. He explains why four centrally located oil fired package boilers were selected to generate 200 F hot water which is delivered through underground mains to heat all the buildings in this 1200 X 500 ft campus.

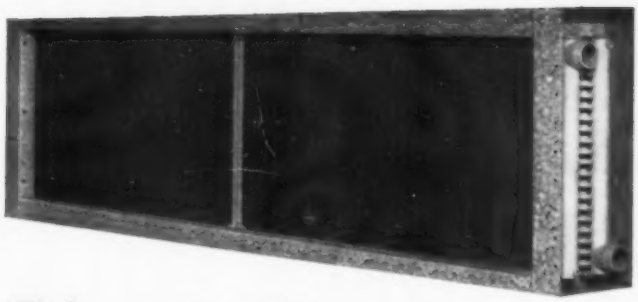
Controlling air pollution resulting from emissions of objectionable gases and vapors is becoming increasingly important. This is especially so as these emissions are introduced into the atmosphere from industrial and commercial processes to the point where atmospheric corrosion takes place, damage to vegetation results, health is affected, and other detrimental results are experienced. The HPAC Engineering Data File on pages 111 to 126 presents the basic methods for controlling these emissions of gases and vapors. The various types of equipment used to collect gases, how they perform, and where they have been used for air pollution control are also presented.

How to design the supports for a horizontal tank is given on pages 72 and 74. The Law and Your Profits is on page 105 where John F. Morrissey cites a case in which the owner's failure to prove negligence saves the heating contractor in a warranty case.

Last month I had an opportunity to visit the U. S. Air Force missile testing facilities at Cape Canaveral and at Eglin Air Force Base. My report of what can be published at this time is in the You'll Want to Know pages on 47 and 48. The facilities at these stations are fabulous, as you can well appreciate, and the magnitude and dependency of the air conditioning and piping services to keep this program rolling would make many interesting articles. As the information can be made available, we will keep you informed.

Bob Roose

Editor, HEATING, PIPING & AIR CONDITIONING



Nesbitt Type WD surface provides . . .

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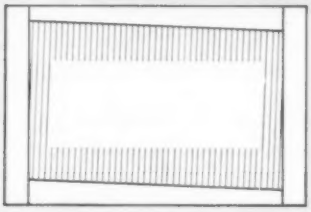
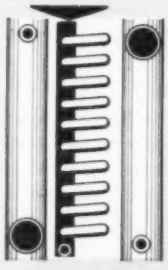


By pitching the core in the casing 3/16″ per foot toward the water inlet end, water flows to the low point where it can be drained from Type WD surface.

AUXILIARY DRAIN HEADERS



In addition to drains in the main headers, Nesbitt also locates auxiliary drain headers at the low end of the section to remove every trace of water from Type WD surface.

IT'S A FACT . . . Nesbitt offers the only really drainable continuous tube water surface. Unlike conventional surfaces that rely on header and piping drains, Nesbitt Type WD water surface combines the effect of pitch (3/16″ per foot) with the use of auxiliary drain headers (in addition to main header drains) to assure positive drainage of all tubes and return bends. Every trace of water can be drained from the section . . . none can be trapped and subjected to subfreezing air. Consequently, Nesbitt Type WD surface provides unexcelled protection against freezing.

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Philadelphia 36, Penna.

4-D WROUGHT IRON STEAM RETURN LINES

STEAM CONDENSATE CORROSION: the cause, the effect, and a suggested safeguard

4-D represents the most significant development in the history of wrought iron metallurgy. It was achieved by substantially increasing the deoxidation of the base metal, slightly increasing the phosphorous content and using a more siliceous iron silicate. Result is increased corrosion resistance, improved mechanical and physical properties.

Write for new 4-D Wrought Iron literature and our special report, The Use of Wrought Iron in Steam Condensate Lines. A. M. Byers Company, Clark Building, Pittsburgh 22, Pa.

WHAT CAUSES STEAM CONDENSATE—Steam, losing its heat, turns to moisture as temperature drops below saturation level. This condensate is distilled water, greedy for gases. Any gas in the steam is readily absorbed into this condensate as it cools. The condensate becomes violently corrosive to ordinary piping materials, depending upon the percentage of free CO_2 plus O_2 in the steam.

EFFECT OF STEAM CONDENSATE ON PIPE—Carbon dioxide is the primary cause of return line corrosion. Like oxygen, carbon dioxide is present in all raw waters and may enter the boiler with the feed water. Most of the carbon dioxide found in the steam cycle results from decomposition of the bicarbonate or carbonate content of the boiler feed water. Build-up of insoluble products of corrosion—particularly in smaller lines—may plug the pipe and render it useless. Corrosion may cause grooving, channeling, pitting, completely penetrating the pipe wall.

A PIPING MATERIAL THAT COMBATS IT—New 4-D Wrought Iron is a two-component metal consisting of high purity iron and iron silicate fibers. There are over 250,000 non-rusting glasslike fibers to every cross-sectional square inch. The purity of the iron itself, plus the protection of the iron silicate fibers are a mighty formidable deterrent to steam condensate corrosion and its deleterious effects.

BYERS 4-D WROUGHT IRON

NOW OCTAGON'S

VENT-X-IT

Manufactured under one or more of the following patents:
2,649,044 2,854,916
2,665,647 2,868,105
2,687,683 2,868,106
and other patents pending.

The Volume Roof Ventilator Of Handsome Craftsmanship

● Looks good—acts good—is good at exhausting masses of obnoxious air Designed for low silhouette buildings that require more dependable ventilation, VENT-X-IT is manufactured in a variety of sizes and capacities with either direct or belt driven axial or centrifugal backward curved non-overloading fans. Heavy gauge spun aluminum housing throughout will last the life of the building, maintenance is practically nil, and installation as simple as putting on your hat. Can be supplied without fans and motors for air intake or as relief ventilators.

The VENT-X-IT is an important member of the complete line of Octagon roof ventilators. From the smallest shop to the largest industrial plant there is a powered or gravity Octagon for all conditions and volume of air.

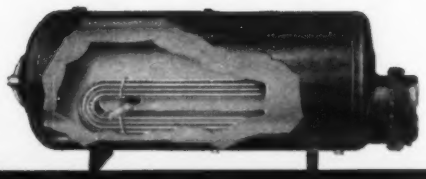
Capacities rated in accordance with standard test codes by the Texas Engineering Experiment Station.

OCTAGON VENTILATOR CO.

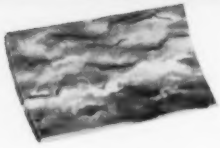
CUSTOM CONSTRUCTION AT PRODUCTION LINE COST

5828-30 SOUTH OAKLEY AVENUE • CHICAGO 36, ILLINOIS

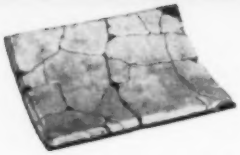
SPECIAL CEMENT LINING
for storage water heaters



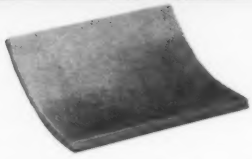
PRE-KRETE® ADDS YEARS OF RUST-FREE SERVICE



Plain steel plate corrodes even under normal water conditions.



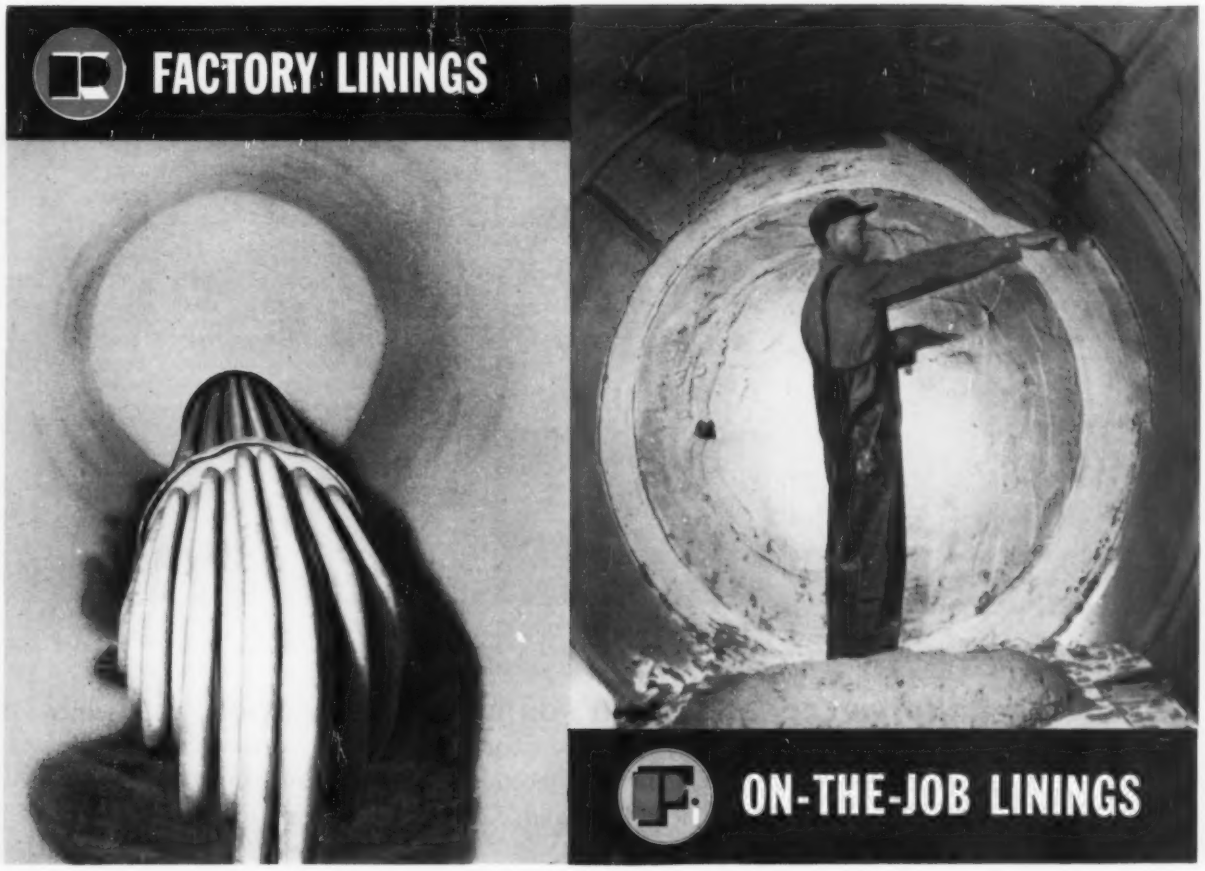
Ordinary cement linings tend to flake, crack and shrink, resulting in high maintenance costs.



Pre-Krete lining remains in perfect condition after exhaustive testing.

SPECIAL FORMULA C-17 PRE-KRETE is a rust and corrosion resistant hydraulic cement lining for steel storage water heaters. It is extraordinary in composition and uniformity. With the aid of special additives, it doesn't chip, crack or flake even at temperatures up to 900°F. Still more important, it is blended in Twin-Shell blenders designed, developed and patented by P-K. An intimate uniformity results that prevents weak spots or "holidays." Maintenance costs are lowered appreciably.

FACTORY LININGS. A P-K Pre-Krete lined water heater costs only slightly more than a plain steel heater, lasts twice as long! A strong, durable ¾" coating is applied, including manhole, coverplate and heating element nozzle. All materials and workmanship are fully guaranteed. And you get



thermal designing that has maintained an unexcelled reputation for over 75 years, plus advanced fabrication techniques that meet all ASME specifications.

ON-THE-JOB LININGS of Pre-Krete give corroded steel vessels – open as well as closed – a long, new life. Unconditionally guaranteed applications are made by franchised applicators of Pocono Fabricators Inc., a division of Patterson-Kelley. Downtime for lining an average vessel: about 48 hours. Also available for "Do-it-yourself" application.

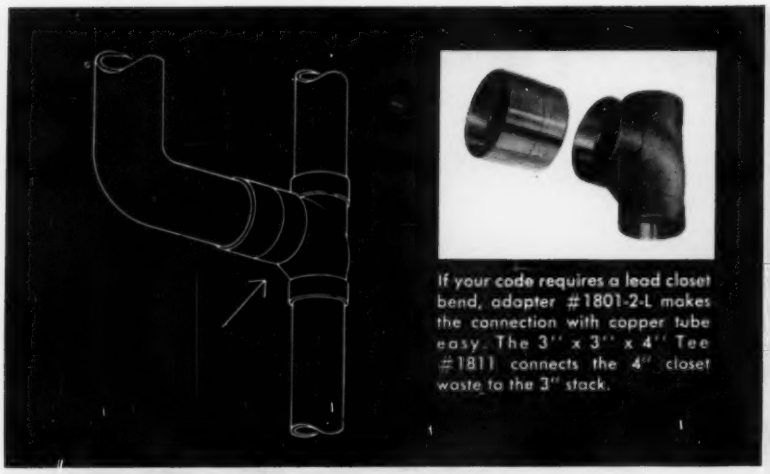
We'd be glad to send descriptive catalogs and more information. Just write, telling us whether you would like to know about new factory lined storage water heaters or on-the-job linings. Address Patterson-Kelley Co. Inc., East Stroudsburg, Pa.

FRANCHISES AVAILABLE. A few Pre-Krete franchise territories remain open in our nationwide network. Franchised applicators are carefully chosen. We'd appreciate your recommendations.

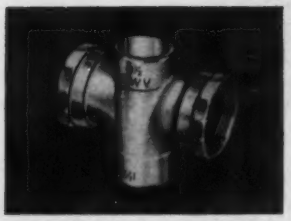
Patterson Kelley

Water Heater Division

storage water heaters • instantaneous heaters • convertors • freon waterchillers • water to water exchangers • gas fired storage water heaters

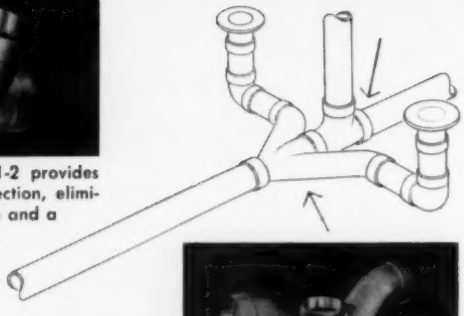


If your code requires a lead closet bend, adapter #1801-2-L makes the connection with copper tube easy. The 3" x 3" x 4" Tee #1811 connects the 4" closet waste to the 3" stack.

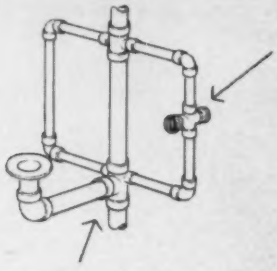


For back-to-back waste lines, fitting #1835-3-3 lets you install threaded nipples prior to plastering.

Sanitary Tee #1811-2 provides fitting-to-fitting connection, eliminating a short nipple and a soldering operation.



Double long turn T-Y #1836 eliminates the double Y-branch and 45° elbows combination.



Here's new time-saver—required by some codes — #1870. Note center line of side inlets is above center line of the main 3" inlet.

A FEW TYPICAL EXAMPLES OF TIME-SAVING ANACONDA FITTINGS

THERE IS A "RIGHT" ANACONDA FITTING FOR EVERY CONNECTION. With solder-joint fittings, a copper tube drainage system is roughed in quickly and easily—even when the work is overhead or in tight quarters. And there are many Anaconda fittings that save you still more time, effort and cost because they eliminate the need to assemble several fittings or a combination of fittings and short nipples. Do you have our *Catalog C-12* "Anaconda Copper Tube Fittings and Valves"? Every size (from $\frac{3}{16}$" through 12") and type you need for general plumbing, heating, air-conditioning and refrigeration is listed for ready reference and ordering. Write: The American Brass Co., Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

25909

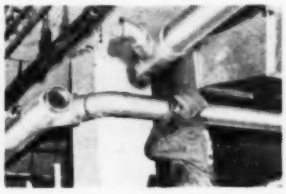
ANACONDA® **COPPER TUBE AND FITTINGS for soil, waste and vent lines**

Available through plumbing wholesalers. Products of The American Brass Company

Longer Lengths—Fewer Joints

Preassembly—Saves Time

Lightweight Copper—Easier Installation



Compact Connections—Save Space

IT MAKES SENSE !

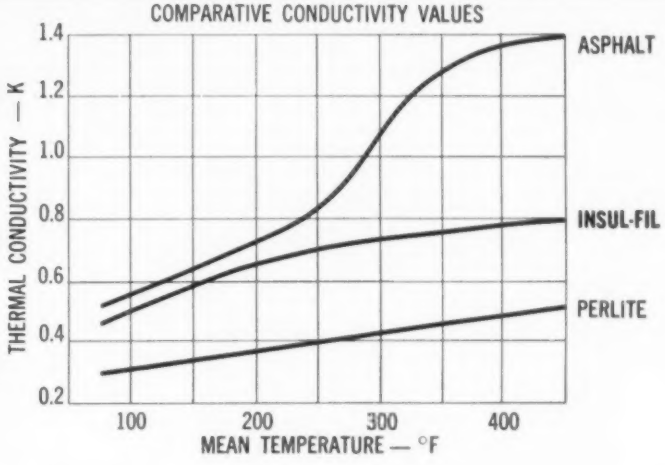
TO INSULATE UNDERGROUND PIPING WITH

insul-fil®

1 Introduction of a material such as expanded perlite into a granulated hard asphalt improves the insulating value of the blend.

2 Proper selection of asphalts by softening point to make up asphalt-perlite blends improves the insulating properties of the blend.

3 Introduction of an aggregate, such as perlite, into a granulated asphalt improves the mechanical properties of the blend once it is plasticized.



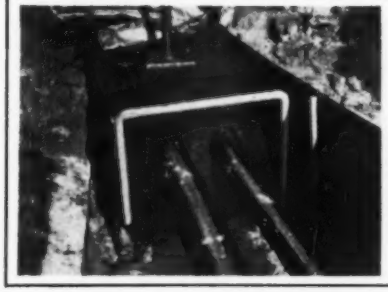
After years of extensive testing conducted at the Research and Development Department of The Atlantic Refining Company, these conclusions were presented in a Paper given before the American Chemical Society in Dallas, Texas, April, 1956. Since that time, hundreds of Insul-fil field installations have confirmed these conclusions.*

It is a well-known fact that the use of asphalt in construction created the necessity for the introduction of fillers (usually inorganic) of various types for the purpose of arresting the flow characteristics and improving the insulation value of the asphalts themselves.

The blend of hard granular asphalt and asphalt coated perlite gives Insul-fil its excellent insulating properties, water resistance and sufficient structural strength to the insulating body to resist normal soil stresses with the steam on or off.

An important Insul-fil development is the priming of the pipe with Accelerator #7591. The use of accelerator provides continuous adhesion of Insul-fil to the pipe, hastens consolidation, and gives additional protection against corrosion by galvanic action.

**Paper available on request.*



Insul-fil Is Simple To Install

Just pour it around the pipe to be insulated. Prod and tamp it in place and backfill. Heat introduced into the pipe forms the conduit.

Insul-Fil Company Inc.
250 Pettit Avenue
Bellmore, Long Island, N. Y.

Please send literature.

NAME_____

COMPANY_____

ADDRESS_____

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insul-fil

The most efficient Granular Fill Type Insulation for Hot Underground Piping

Insul-Fil Company Inc. DIVISION OF: MIRACLE ADHESIVES CORPORATION, 250 PETTIT AVENUE, BELLMORE, LONG ISLAND, N. Y.

New TIME & LIFE BUILDING

Accents Comfort and Economy with

JOHNSON PNEUMATIC CONTROL

The new Time & Life Building in New York's Rockefeller Center will contain over 1½ million square feet of comfortably air-conditioned office space. To provide an ideal working climate throughout this 48-story structure, a specially planned Johnson Pneumatic Temperature Control System will direct the operation of the 60 central fan air conditioning and ventilating systems and the 16 secondary water systems serving the perimeter induction units.

On the 20 floors occupied by Time Inc., publishing deadlines require many departments to work at night and on weekends, while others will have a conventional workweek. To meet this unusual schedule with large savings in operating costs, special control provisions will allow air conditioning to be on or off at any time on a selective basis in each of four zones per floor. These floors, of course, also are equipped with a high degree of *individual room* control.

In planning and installing control systems for buildings such as this, the specialized Johnson organization offers experience that is unmatched in the industry. When you build or air condition, take advantage of the comfort, efficiency, and economy of a pneumatic control system by Johnson.

Johnson Service Company, Milwaukee 1, Wisconsin. Direct Branch Offices in Principal Cities.

JOHNSON CONTROL

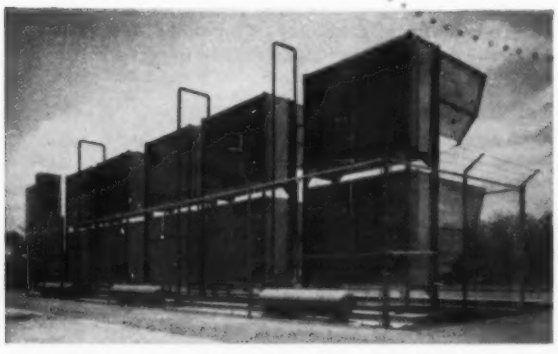
PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

Time & Life Building, New York. Harrison & Abramovitz & Harris, architects; Syska & Hennessy, Inc., mechanical engineers; George A. Fuller Co. and John Lowry, Inc., general contractors; Almirall-Wolff & Munier, mechanical contractors; all of New York.

The Avalanche Journal Building, Lubbock, Texas. W. A. McMillan, Architects; Hedrick and Stanley, Engineers; Anthony Co., Mechanical Contractors.

with McQuay AIRCONS for this Texas Newspaper Plant



Remote McQuay horizontal air flow Aircon installation with wind deflectors at Avalanche Journal Building, Lubbock, Texas.

IN LUBBOCK, TEXAS, where the weather is both hot and dry, and water is a problem, this bank of 10 McQuay Aircons furnishes 280 tons of refrigerant condensing for the new plant of the Avalanche Journal.

Engineers and architects like McQuay Aircons because of their flexibility and their operating and installation economy. McQuay Aircons are made in 8 models from 7½ to 75 tons capacity in a single unit in either vertical or horizontal air flow models. Unlimited capacity is available in multiple unit installations.

You not only get more models and more capacity, you get more performance, because McQuay Aircons have the exclusive Mc Quay Ripple-Fin coils—the finest and the standard of the industry.

The McQuay "Seasontrols", automatic head pressure controls, are available as accessories, and modulate the condenser capacity in accordance with the weather for proper operation at all times. For complete information, call the McQuay representative in or near your city, or write McQuay, Inc., 1601 Broadway Street N.E., Minneapolis 13, Minnesota.

McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION

McQuay Means Quality

HUSSEY COPPER SAVES THREE WAYS

MATERIAL SAVINGS

The building trades now recognize that copper can be less expensive on the job because in many ways *less* copper does a *bigger* job—resulting in material savings. No other metal has as many exclusive advantages working in your favor.

ON-SITE SAVINGS

Copper is easy to work with. It's easy to form on the job . . . easy to join . . . solders readily . . . and its flexibility serves you in the "tight spots" like snaking tubing in confined areas or hand forming sheet metal.

PREFAB SAVINGS

Shop prefabricated plumbing trees . . . easily formed and rapidly soldered . . . are one of the best examples of prefab savings done with all the advantages of shop equipment. You can think of many other ways this easy working metal saves more labor than its cost.

To be sure . . . make sure it's Hussey Copper. There are seven handy warehouses to serve you.

HUSSEY

COPPER PRODUCTS

Sheets • Strip • Rolls • Wire • Tubing • Pipe • Rounds
Squares • Hexagons • Copper Roof Drainage Products
Copper Building Products

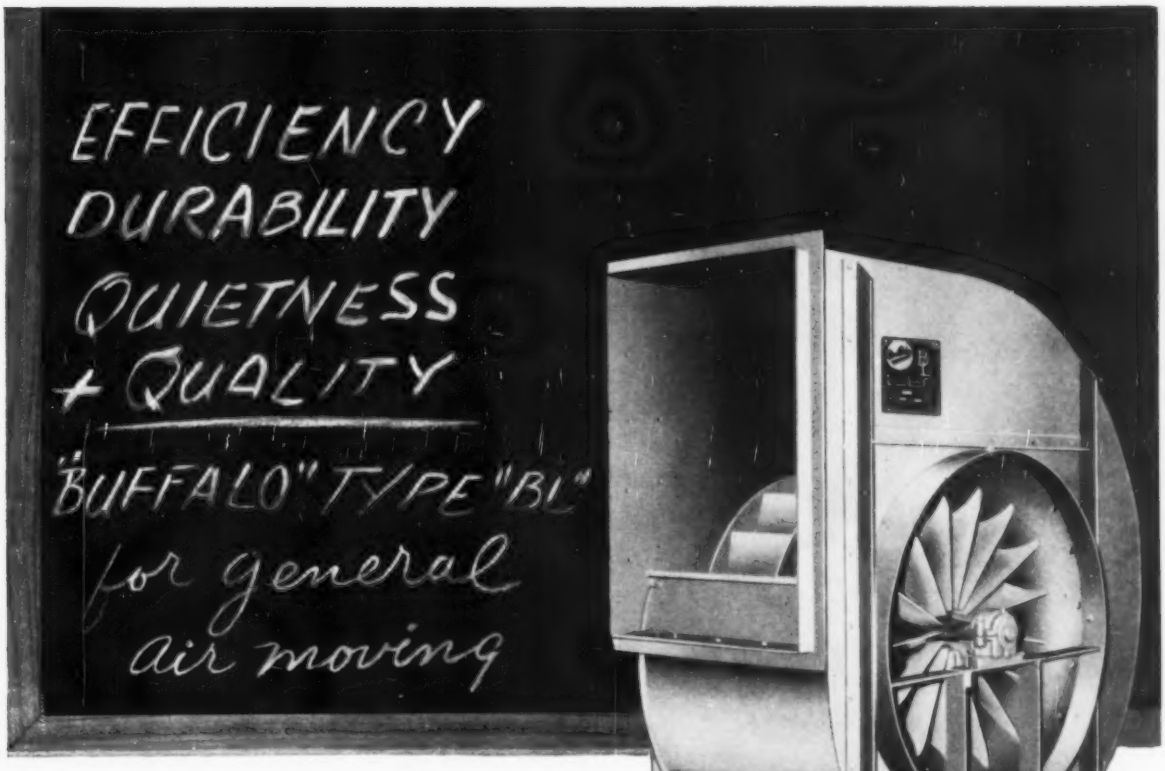
C. G. HUSSEY & CO.

(Division of Copper Range Co.)

Rolling Mills and General Offices
PITTSBURGH 19, PA.

7 CONVENIENT WAREHOUSES

PITTSBURGH (19) 2850 Second Ave.	**CLEVELAND (3)** 5318 St. Clair Ave.	**CINCINNATI (37)** 1045 Meta Drive	**CHICAGO (18)** 3900 N. Elston Ave.
ST. LOUIS (1) Globe Democrat Bldg.	**PHILADELPHIA (30)** 1632 Fairmount Ave.	**NEW YORK, LONG ISLAND CITY (6)** 34-39 Thirty-first St.	



All the things you want for satisfactory air handling at moderate pressures are embodied in the "Buffalo" type "BL" Fan. High efficiency, quiet operation and quality of construction* lead to unparalleled durability on the job. Here are several of the reasons why you will be more than satisfied with this well engineered fan:

- *Inlet* — Minimum turbulence is assured by the smoothly-curved inlet bell. Air flow is further smoothed by directional guide vanes and matching shroud.
- *Wheel* — Streamlined wheel with backward-curved blades achieves peak efficiency. Factory tested and balanced wheel minimizes vibration.
- *Housing* — Smooth air flow is enhanced by the correctly shaped scroll of the wheel-contoured housing.
- *Non-overloading characteristic* — quiet, stable output is provided from free delivery to shutoff.
- *Rugged, durable construction* — Extra-heavy at points of greatest strain and wear — gives long, maintenance-free service.
- *Highest Quality* — backed by the "Buffalo" reputation of 82 years in the air moving field.

For complete details on the "Buffalo" Type "BL" Fan Series, contact your "Buffalo" engineering representative. Or write direct for Bulletin F-104.

*Every "Buffalo" Fan brings you the famous "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life.

"Buffalo"

BUFFALO FORGE COMPANY

Buffalo, N. Y.

Buffalo Pumps Division, Buffalo, N.Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

Zero in on Frozen Foods with genetron®

SUPER-DRY REFRIGERANTS

Ask any producer of frozen foods and he'll tell you. Actual zero temperature is *always* needed to maintain high quality and to protect product freshness. That's why, whether you package, store, ship or merchandise frozen foods, you need the sure protection of modern refrigeration equipment...and dependable "Genetron" fluorinated hydrocarbon refrigerants.

"Genetron" super-dry refrigerants are universally accepted for use as original or replacement charge in modern frozen food refrigeration systems. Leading equipment manufacturers approve them. Refrigeration engineers specify them. Wholesalers recommend them. Servicemen and contractors know they can depend on them. That's because "Genetrons" offer unexcelled purity and dryness . . . and their strict quality specifications are consistently *bettered* in production.

"Genetrons" are available from refrigeration and air-conditioning wholesalers from coast to coast. See your wholesaler. Insist on "Genetron"!

Quick Facts on "Genetron" Super-Dry Refrigerants

- Guaranteed exceptionally low moisture content
- Noncorrosive to standard equipment materials, nontoxic, nonflammable, stable, safe
- Critical and freezing points well outside range of operating uses
- Solvent action on oil helps prevent solidification or congealing of lubricant; aids in lubrication of equipment; generally miscible with oil
- Freely interchangeable and may be mixed in any proportions with comparable fluorinated hydrocarbons meeting the same strict refrigerant specifications

genetron 11 ORANGE LABEL CCl_3F TRICHLOROMONOFLUOROMETHANE
genetron 12 WHITE LABEL CCl_2F_2 DICHLORODIFLUOROMETHANE
genetron 22 GREEN LABEL $CHClF_2$ MONOCHLORODIFLUOROMETHANE
genetron 113 PURPLE LABEL $C_2Cl_3F_3$ TRICHLOROTRIFLUOROETHANE
genetron 114a BLUE LABEL $C_2Cl_2F_4$ DICHLOROTETRAFLUOROETHANE

Basic to America's Progress

Allied Chemical

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N. Y.

"QUALITY and ECONOMY... SPANG Steel Pipe gave us both"

says Mr. Joseph Yanasheski, Piping Estimator for Joseph A. Rado, Mechanical Contractor, Berwick, Pa.

"One of the biggest problems in our business is to do a first-rate job and still keep costs in line," states Mr. Yanasheski. "With the help of SPANG CW Steel Pipe we were able to do just that at the Berwick, Pennsylvania, Hospital installation. Not only did SPANG Steel Pipe assure us of a reliable performance, but also the economy of using steel pipe helped us keep costs down.

"Another advantage to using SPANG Steel Pipe is its good welding qualities. By welding instead of threading the pipe, we achieved a considerable savings in time costs and eliminated the danger of leakage at the joints."

KEEP YOUR INSTALLATION COSTS DOWN, TOO... WITH SPANG CW STEEL PIPE

When you use SPANG CW Steel Pipe you get *top-quality*, money-saving performance. Why? Because SPANG Pipe is *quality-controlled* during manufacturing and thoroughly tested before shipping. Your SPANG Distributor can give you the fast, efficient service you require. Next job, make it steel pipe . . . make it SPANG.

SPANG CW STEEL PIPE

THE NATIONAL SUPPLY COMPANY

Subsidiary of Armco Steel Corporation

TWO GATEWAY CENTER, PITTSBURGH, PA.

20,000 feet of SPANG CW Steel Pipe fulfilled all the pipe requirements for the Berwick Hospital . . . in the air conditioning and heating units, sterilizer room and laundry. Here in the 40' x 65' boiler room, the SPANG Pipe runs in the ceiling so that there is no interference with the concrete-laying operation during construction.

Mechanical Contractor: Joseph A. Rado, Berwick, Pa.

Architect: Noakes and Neubauer, Washington, D.C.

Hospital Consultant: Gordon A. Friesen Associates, Washington, D.C.

Mechanical & Electrical Consultant: Shefferman and Bigelson, Washington, D.C.

SPANG Distributor: Busser Supply Company, Lewisburg, Pa.

BEFORE YOU BUY, THINK:

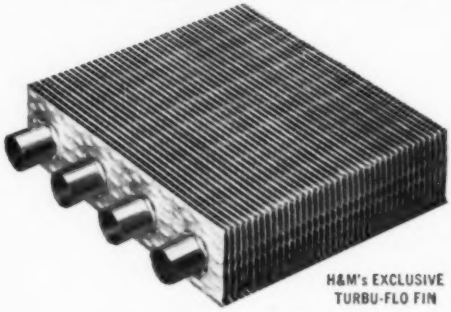
Do you need 6, 7, 8 or 10 fins per inch?

Halstead & Mitchell supplies Turbu-Flo Coils with the fin spacing you want

Why accept someone else's "standard" when your own judgment dictates another fin spacing for the specific job at hand. Now you can call on Halstead & Mitchell for Turbu-Flo coils with 6, 7, 8 or 10 fins per inch to meet your individual size requirements.

H&M makes coils for use with most refrigerants, steam (standard or non-freeze coils), hot or chilled water. All coils are available from 1 to 8 rows deep, with finned heights of 12 to 36 inches, and finned lengths up to 10 feet. Aluminum fins on seamless copper tubing are standard, though copper fins may be ordered. Casings come in heavy gauge galvanized steel or aluminum, with connections for left or right hand.

When perfect performance depends on correct design, specify H&M coils. Ask your wholesaler for complete information or write to Halstead & Mitchell, Bessemer Bldg., Pittsburgh 22, Pa.



H&M's EXCLUSIVE TURBU-FLO FIN

HM

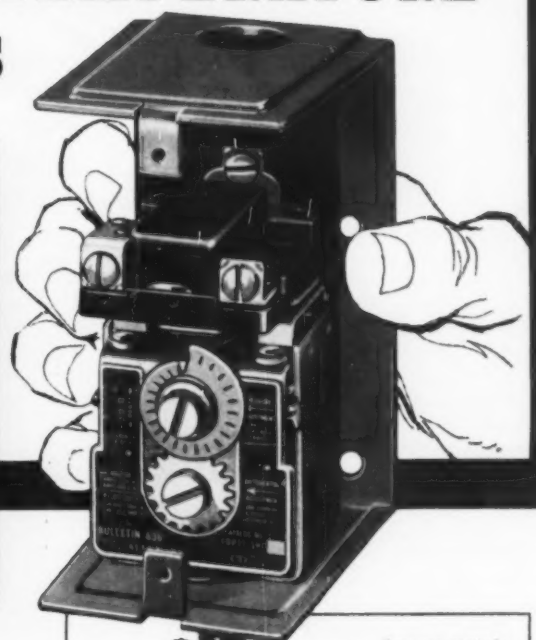
Halstead & Mitchell

Finned Coil Products • Air-Cooled Condensers • Water-Cooled Condensers • Cooling Towers

NEW

Allen-Bradley Air Conditioning and Refrigeration

PRESSURE and TEMPERATURE CONTROLS



A-B QUALITY

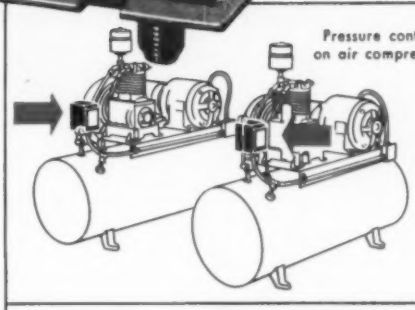
Longer Life
Lower Differentials
Attractive Appearance

Using an improved bellows design, these *new* A-B controls combine exceptionally low differentials with extremely long life — even when cycled from zero to maximum setting. Both the range and differential setting are easily adjustable —and a scale shows the operating point of the control.

The precision snap-action switch in these controls has no "dead center"—operation is absolutely positive. Vibration or mounting angle cannot cause faulty operation. And the pure silver contacts assure millions of trouble free operations—without maintenance.

For accurate and reliable control of pressure or temperature, you'll find nothing to equal these new controls—they're A-B *quality* throughout. Don't delay — write for details.

Allen-Bradley Co., 1335 S. First St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.



Pressure controls on air compressors

Bulletin 837 Temperature Control equipped with capillary tube and bulb.

Bulletin 836 Pressure Control for low pressures.

Bulletin 836 Pressure Control in NEMA Type 4 enclosure.

TEMPERATURE RANGES
From −150°F to 490°F

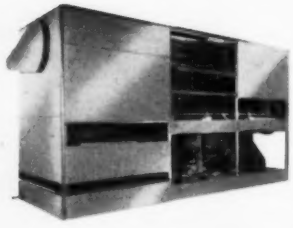
PRESSURE RANGES
From 30" vacuum (Hg) to 900° psi

ALLEN-BRADLEY Quality Motor Control

CITIES SERVICE OIL COMPANY — ROMA WINE COMPANY — ALLEN B. DUMONT LABORATORIES, INC. — AMERICAN AIRLINES, INC. — GENERAL SERVICES ADMINISTRATION — J. M. FIELDS STORES — U. S. ARMY — FROZEN RITE, INC. — PACIFIC TELEPHONE & TELEGRAPH COMPANY — TEXAS FASTENER CORPORATION — RONEY PLAZA HOTEL — UNIVERSITY OF SOUTHERN CALIFORNIA — PHILLIPS PETROLEUM COMPANY — CHICAGO BRIDGE & IRON — GENERAL ELECTRIC — ATLANTIC & PACIFIC TEA COMPANY — ROBERT HALL CLOTHIERS — HUMBLE OIL COMPANY — OLIN MATHEISON — LOCKHEED AIRCRAFT AREOJET — SYLVANIA ELECTRIC — F. W. WOOLWORTH COMPANY — KAISER ENGINEERING CORPORATION — U.S. NAVY SAFEWAY STORES — CONVAIR — ATOMIC ENERGY COMMISSION — CONTINENTAL BAKING COMPANY — REPUBLIC AVIATION — FOOD FAIR STORES — NATIONAL CASH REGISTER — BURROUGHS CORPORATION — FEDERAL HOUSING ADMINISTRATION — EDISON COMPANY — RAND McNALLY & COMPANY — MINNESOTA MINING & MANUFACTURING BANK OF AMERICA — U.S. AIR FORCE — NEW YORK [illegible] COMPANY — FRANKLIN STORES — NATIONAL FOOD STORES — CENTRAL CASUALTY INSURANCE COMPAN[illegible] COMPANY — PACIFIC GAS & ELECTRIC — RADIO CORPORATION OF A[illegible] KY LAGER BREWING GENERAL [illegible] T STORES SEARS & [illegible] — STATE FARM INS[illegible] - MUZAK CORPORA[illegible] PORATION BOND STO[illegible] NSURANCE COMPANY [illegible] REFINING COMPANY [illegible] COMPANY NEW ENGLAND TELEP[illegible] LONIAL STORES, INC. GLENN MANUFACTURING COMPANY — CURTIS WRI[illegible] - EL MUNDO, INC. — U. S. PLYWOOD — FORD MOTOR COMPANY OF CANADA, LTD. — DIPLOMAT HOT[illegible]NILD CAMERA & INSTRUMENT COMPANY — AMERICAN THERMOS PRODUCTS — PACIFIC MURPHY MANUFACTURING CORPORATION — THE MAYTAG COMPANY — INTERNATIONAL BUSINESS MACHINES — NATIONAL BISCUIT COMPANY — ASIATIC PETROLEUM CORPORATION — INSULAR CHEMICAL COMPANY STANDARD LIFE & ACCIDENT COMPANY — EASTMAN KODAK COMPANY — UNIVERSITY OF OKLAHOMA — BELL AIRCRAFT MONARCH METALS WEATHERSTRIP COMPANY — McDONNELL AIRCRAFT CORPORATION — BETHLEHEM STEEL COMPANY — B-THRIFTY STORES, INC. — WAYNE PUMP COMPANY — ARMA CORPORATION — THREAD, INC. — AMERICAN OIL COMPANY TRANSCON FREIGHT LINES — AMERICAN CAN COMPANY — KANSAS CITY FIRE AND MARINE INSURANCE COMPANY — T G & Y STORES — BRITISH OVERSEAS AIRWAYS CORPORATION — RAND McNALLY & COMPANY — NEW YORK TELEPHONE COMPANY WESTERN ELECTRIC COMANY — AMERICAN MACHINE & FOUNDRY — W. T. GRANT COMPANY — PIGGLY-WIGGLY FOOD STORES J. C. PENNEY COMPANY — PENN FRUIT STORES — RUTGERS UNIVERSITY — U. S. MARINE CORPS — HOWARD JOHNSON'S KROGER COMPANY — CIVIL AERONAUTICS ADMINISTRATION — E. I. DuPONT De NEMOURS & COMPANY — SAHARA HOTEL

GOVERNAIR

GOVERNAIR PRODUCTS ARE NOW IN USE BY THESE DISTINGUISHED ORGANIZATIONS



Model SCMZ

Self-contained Multi-Zone air conditioner — one of 18 basic Self Contained equipment models, available from 3 to 120 tons.

Model GMZ

Governair also "Satisfabricates" a complete line of Vertical, Horizontal and Multi-Zone Air Handling Units.

"SATISFABRICATED"©

. . . that's the copyrighted term that describes Governair air conditioning . . . equipment which is so basically flexible in design, that it can be manufactured to fit almost *any* space and load requirement.

This beneficial feature, pioneered and developed by Governair, is coupled with imaginative, tested engineering and quality workmanship. The end result is an installation that's a much *wiser* dollar investment.

Write for detailed information, or consult your yellow page directory for the name of our local representative.

THE GOVERNAIR CORPORATION
4840 N. SEWELL • OKLAHOMA CITY

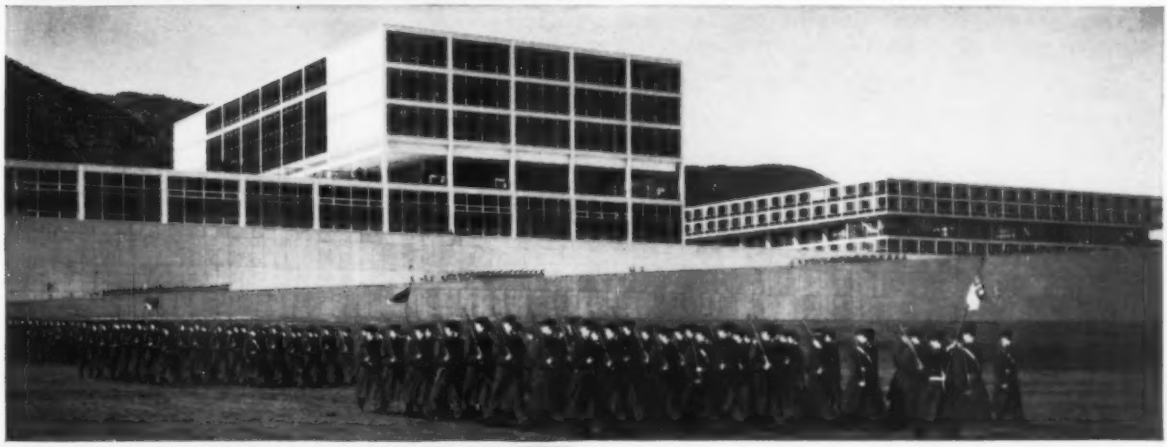
27,000 feet of heat...

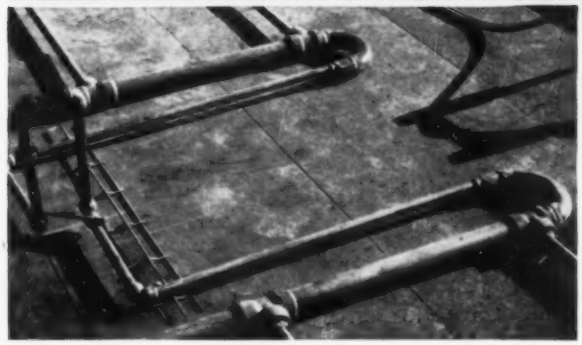
Here, at the U. S. Air Force Academy, near Colorado Springs, Colorado, the most modern equipment in the world has been used to provide for the comfort and safety of America's future sky-generals. For instance, a huge radiant heating installation, featuring almost 27,000 feet of ¾-inch USS National Steel Pipe, serves the Cadet Quarters Complex.

For installations such as the Air Force Academy, architects and contractors consistently look to USS National Pipe. As a matter of fact, they've been specifying National for more than 60 years for conventional plumbing and heating systems. It makes sense, too! You know why? Because National Pipe has the qualities to meet the requirements of these applications . . . smooth, uniform bending . . . sound, strong welding . . . and long service life. These qualities have made USS National Pipe the largest selling pipe in the world. For more information, write to National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS and National are registered trademarks

The world's largest and most experienced manufacturer of tubular products





National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York

Specify Skidmore HEATING PUMPS

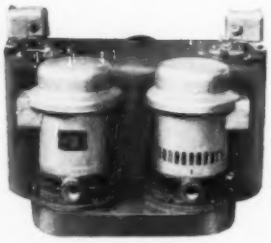
One is just right for your application

2 New Bulletins

No. 21-C

TYPE **CCVS**

redesigned



DUPLEX UNIT

SINGLE UNIT

Two outstanding vertical type pumps shown at right are fully described in the new Bulletin 21-C. Combining the latest features of centrifugal pump design — the New "CCVS" Pump is built in three single sizes and the duplex unit in either the two float switch or automatic alternator type.

Send for Bulletin No. 14-B

TYPE HS

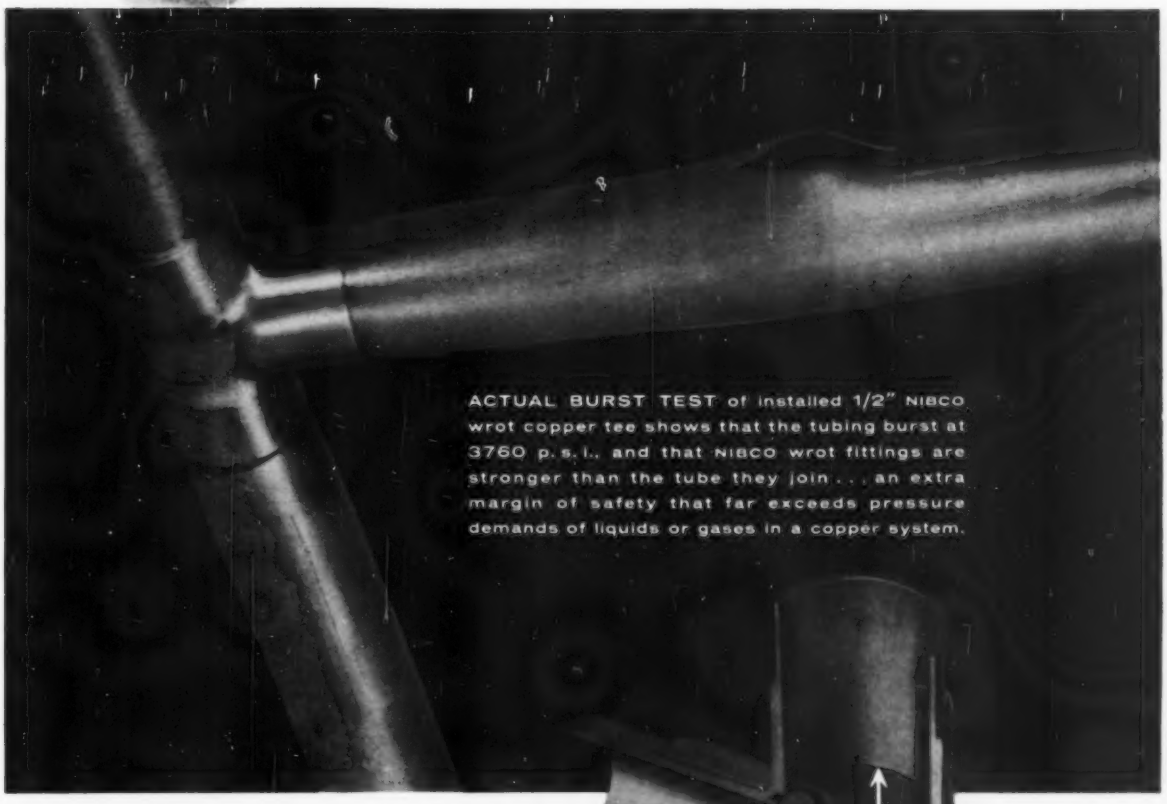
The economy HS Pump is especially well constructed with stainless steel shaft and bronze-fitted throughout. New capacities of the SKIDMORE HS Pump range from 1,000 to 125,000 sq. ft. E.D.R. with discharge pressures from 10 to 75 lbs. Pump is built in both single or duplex unit, and is mounted on steel base or cast iron if desired. Write for complete engineering data on this or other pumps.

Sales Representatives in Principal Cities

SKIDMORE PUMPS **SKIDMORE CORPORATION** ST. JOSEPH MICHIGAN

When you compare copper fittings...

remember David and Goliath!


ACTUAL BURST TEST of installed 1/2" NIBCO wrot copper tee shows that the tubing burst at 3760 p.s.i., and that NIBCO wrot fittings are stronger than the tube they join . . . an extra margin of safety that far exceeds pressure demands of liquids or gases in a copper system.
ZONE OF STRENGTH

Like David of old, NIBCO wrot copper fittings are strong where it counts. Wall thicknesses in the NIBCO "zone of strength" (as shown in the cutaway tee, for example) are not made to the "L" minimum ASA standard, but have heavier than "K" wall thickness of metal... additionally densified in processing. This is but one reason why NIBCO fittings are specified by the nation's leading contractors and service organizations. See your NIBCO wholesaler, or send coupon for ***FREE CATALOG.***

NIBCO

NIBCO INC.—Dept. J-6412, Elkhart, Indiana

Please send "Catalog I" of NIBCO fittings.

name _____

firm _____

address _____

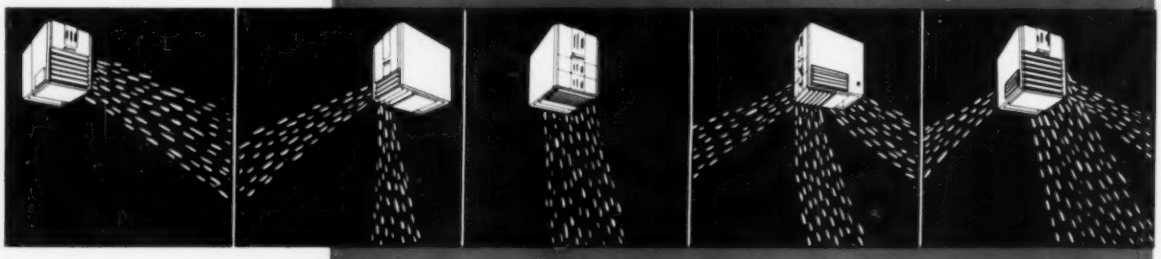
city, state _____

NEW MD

Humphrey BY ARKLA MULTI-DIRECTIONAL

AUTOMATIC GAS UNIT HEATER

FIRST to deliver Warm Air STRAIGHT DOWN and from front and sides



The **MD** is the **FIRST** unit heater with interchangeable and optional **LOUVERS** that can be installed on the job, to provide the **MOST EFFECTIVE** air circulation for each individual installation.

The **MD** is equipped with top-mounted fan, unique "open-top" heat exchanger, and completely enclosed controls. May be ducted to use 100% outside air for combustion, or installed in batteries of several units using same piping, wiring and vent.

Receive **BETTER HEATING** with **FEWER HEATERS** . . . with a **HUMPHREY MD** . . . available in 11 sizes, 60,000 to 270,000 btu.

Humphrey
DIVISION
ARKLA
AIR CONDITIONING
CORPORATION
GENERAL SALES OFFICES
SHANNON BUILDING
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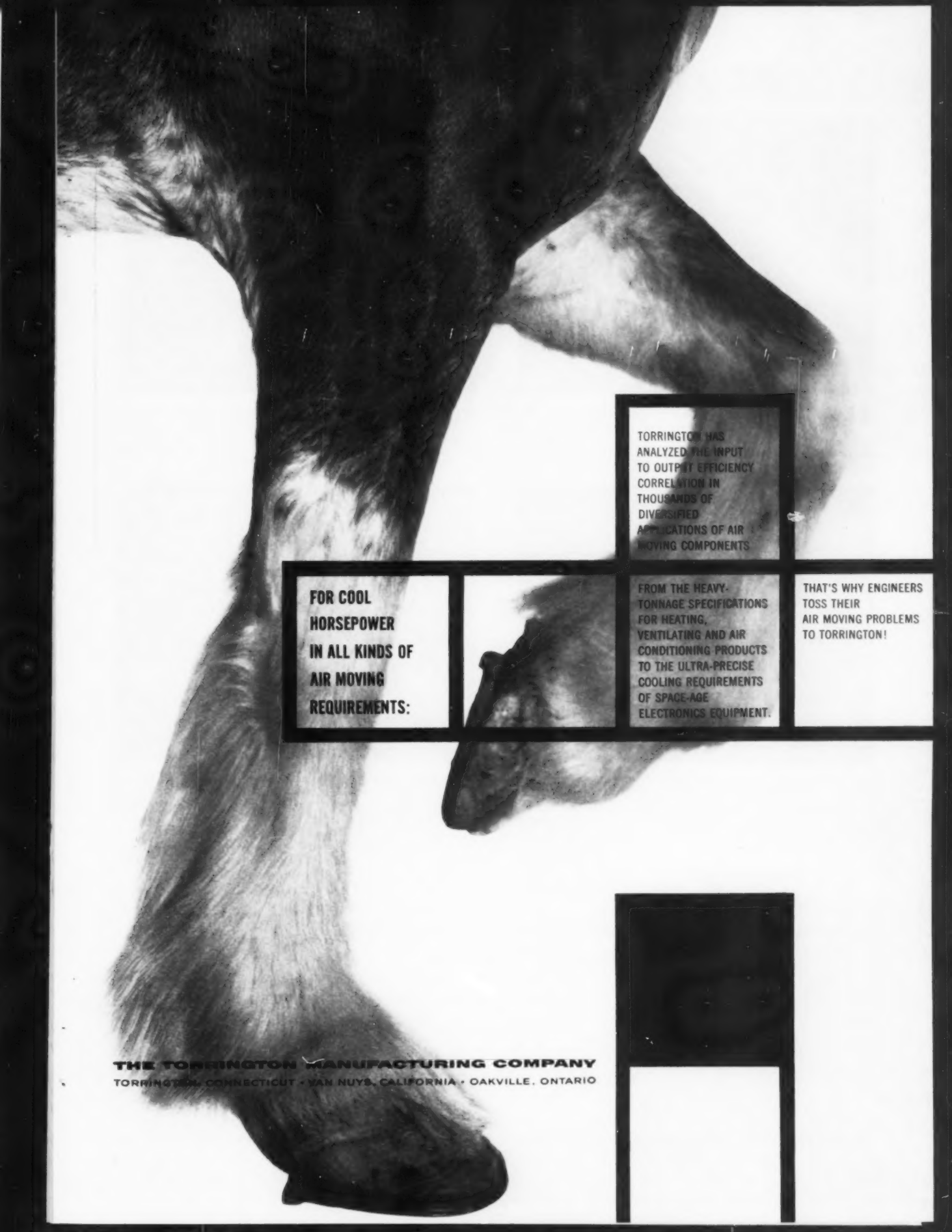
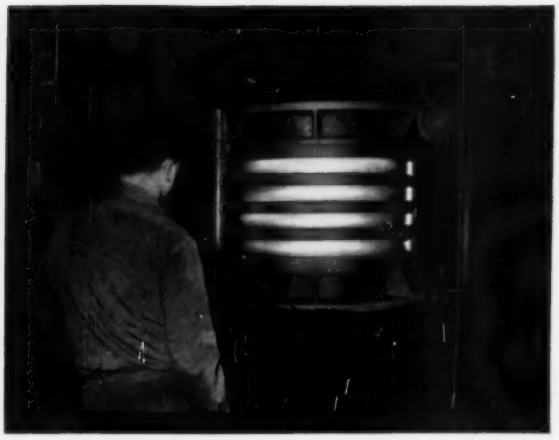
ARKANSAS

OTHER ARKLA GAS APPLIANCES

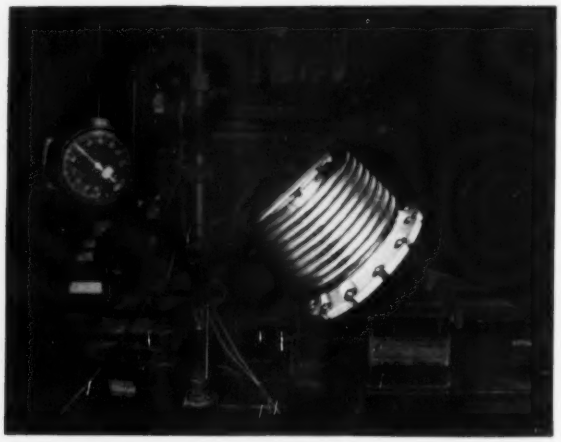
DEALERSHIPS AVAILABLE IN CERTAIN AREAS • WRITE HUMPHREY DIVISION • ARKLA


TORRINGTON HAS ANALYZED THE INPUT TO OUTPUT EFFICIENCY CORRELATION IN THOUSANDS OF DIVERSIFIED APPLICATIONS OF AIR MOVING COMPONENTS
FOR COOL HORSEPOWER IN ALL KINDS OF AIR MOVING REQUIREMENTS:
FROM THE HEAVY-TONNAGE SPECIFICATIONS FOR HEATING, VENTILATING AND AIR CONDITIONING PRODUCTS TO THE ULTRA-PRECISE COOLING REQUIREMENTS OF SPACE-AGE ELECTRONICS EQUIPMENT.
THAT'S WHY ENGINEERS TOSS THEIR AIR MOVING PROBLEMS TO TORRINGTON!
THE TORRINGTON MANUFACTURING COMPANY
TORRINGTON, CONNECTICUT • VAN NUYS, CALIFORNIA • OAKVILLE, ONTARIO

4 WAYS to get maximum reliability in expansion joints



1 Insist that the corrugated bellows be hydraulically formed. The reason is simple. Whenever bellows are formed by circumferential welding . . . whether by edge, seam or fillet welding . . they will always be subject to premature failure because of stress concentrations at the welds.



2 Be sure the manufacturer maintains a continuous and comprehensive program of endurance testing. This is basic, because of the many variables that affect expansion joint life. Accurate determination of expansion joint life expectancy can only be determined by cycling to destruction.

3 Demand proof that the manufacturer can produce longitudinal welds in the corrugated bellows having the same strength, physical properties and thickness as the parent metal . . . without grinding. A weld that is hard to find is a ground weld. Variations in weld thickness set up points of stress concentration . . . opening the way for premature failure.

4 Check the ability of the manufacturer to supply a team of *competent* design and application specialists to work with your engineers. Check their specific experience in handling critical, complex applications in your field . . . complete to the record of successes or failures behind them, and details of how this experience will be brought to bear on your problem.

At Zallea, none of the many factors affecting expansion joint reliability are left to guesswork . . . including the four vital ones above.

This is reflected in these facts. Zallea material specifications are the most exacting in the industry. Zallea expansion joints are hydraulically formed. Zallea advanced welding techniques insure welds having the same thickness, strength and physical properties as the parent metal. Zallea has done more cyclic testing to destruction than all government agencies and industrial firms combined. Zallea has produced more expansion joints than any other manufacturer . . . offers more application engineering experience.

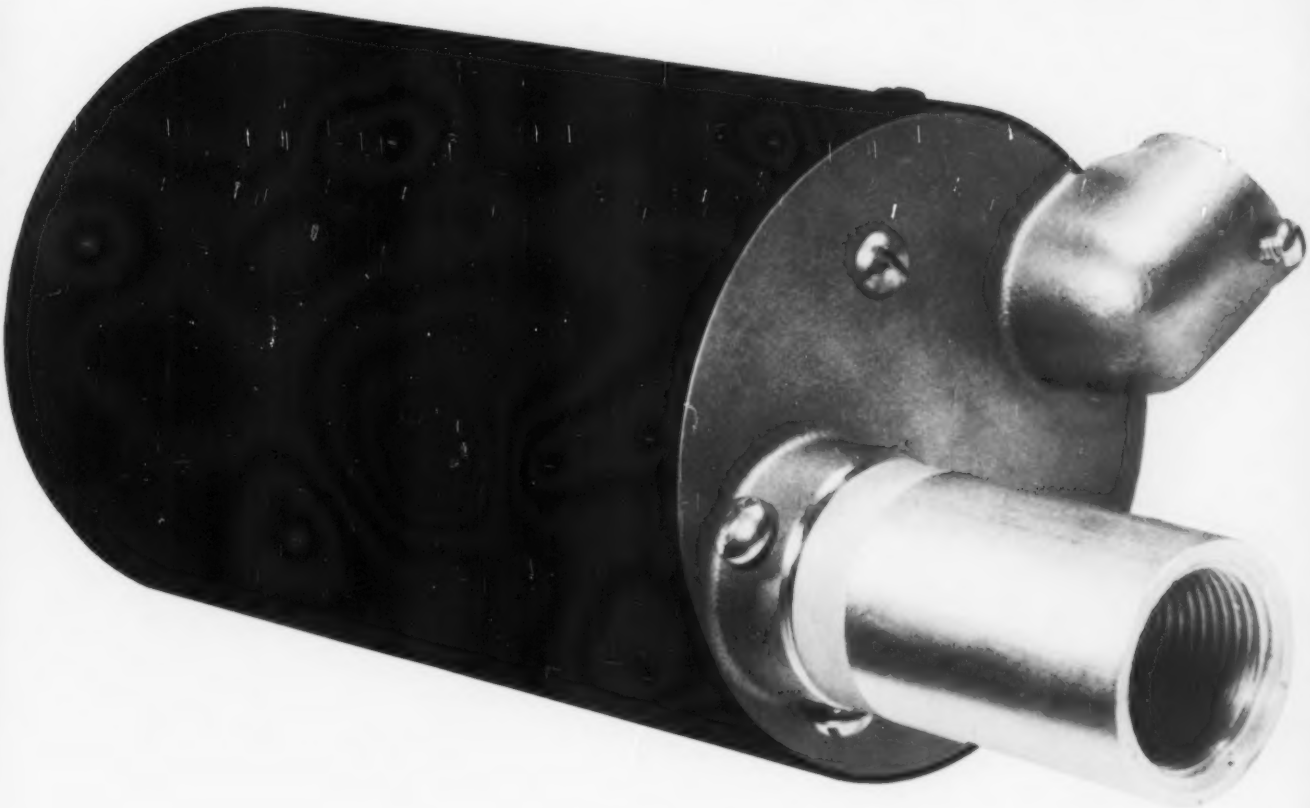
For all the facts, write for Catalog 56. Zallea Brothers, Taylor and Locust Streets, Wilmington 99, Delaware.

Zallea for maximum reliability

ZALLEA BROTHERS, Wilmington 99, Delaware • World's largest manufacturer of expansion joints

HONEYWELL'S NEW C7012A

Ultra-Vision* Flame Detector



senses only the flame!

no more hot refractory hold-ins

USE OF ULTRAVIOLET RAYS REVOLUTIONIZES SAFETY STANDARDS IN FLAME DETECTION DEVICES FOR GAS, OIL AND COMBINATION GAS-OIL INSTALLATIONS

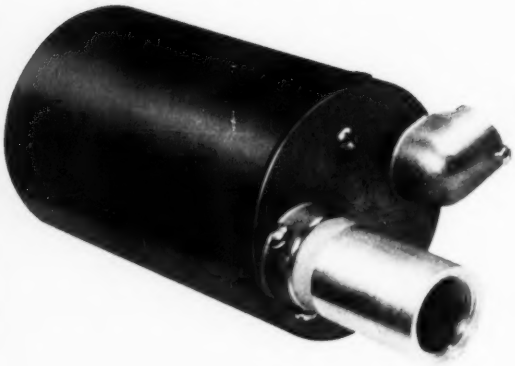
Honeywell's new ultraviolet sensor represents a major breakthrough in scientific flame detection. This revolutionary device employs an amplified ultraviolet signal to positively distinguish between an actual flame (ultraviolet rays) and a hot refractory (infrared rays). For the first time, you can be *absolutely sure* that fuel delivery will be stopped in the absence of flame.

This new control device is compact. It simplifies flame supervision of both single and multiple burners since the Ultra-Vision Detector, not being sensitive to a hot refractory, can be aimed at each individual flame in the most convenient way. This is the only device on the market that offers you this advantage.

Is it economical? Consider this: The amazing new Ultra-Vision Flame Detector will actually pay for itself in simplified installation and maintenance because—

• wiring is less expensive in this system than in a lead sulphide cell • it can be installed easier because in flame sighting hot refractory can be ignored • there is no further need for flame rod replacement.

*Trademark



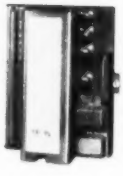
HONEYWELL'S NEW C7012 IS "SYSTEM ENGINEERED" FOR USE WITH ANY 2- TO 4-SECOND FLAME RECTIFICATION RELAY!

The Honeywell Ultra-Vision Flame Detector is designed for safe, foolproof flame detection when used with any of the following flame safeguard relays:

FOR MEDIUM BURNERS—
RA890E PROTECTORELAY
The RA890E is a basic rectification relay ideally suited for use with the new C7012A Ultra-Vision Sensor. It's designed especially for pressure-gun oil burners, small combination gas-oil burners and gas-power burners.

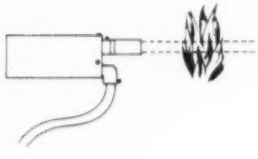
FOR INDUSTRIAL
PROCESSING BURNERS
AND OVENS—
W124 PROTECTOGLO
Provides extended purge timings and cutoff of the main flame. Pushbutton and signal lights are a built-in feature of this system. The Ultra-Vision Flame Detector provides safe, dependable flame detection when used with the W124 Protectoglo.

FOR INDUSTRIAL PROCESSING AND COMMERCIAL BURNERS (requiring manual start and complete cutoff on flame failure)—R485 PROTECTORELAY
Used with the new C7012, the R485 Protectorelay insures trouble-free operation and no "down time"—this system senses only the flame, never a hot refractory. The safety features of the R485 include a warm-up timer, a self-start check and a safe-operation check for immediate shut-down in event of abnormal conditions.

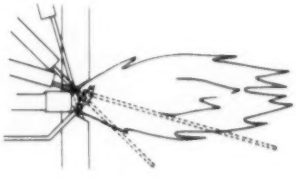


FOR LARGE CONVERSION BURNERS
—R478 PROTECTORELAY
Here's an electronic programming relay for large horizontal rotaries, combination gas-oil burners, steam-atomizing burners and large power gas burners. The R478A may be used with the C7012A Ultra-Vision Sensor when burner sequencing is needed.

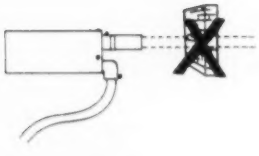
HERE'S WHY HONEYWELL'S NEW C7012 IS SO VERSATILE!



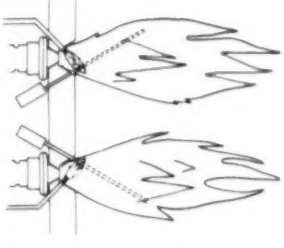
New Ultra-Vision Flame Detector sights flame of all fuels.



New Detector does an effective job on single burner pilot and main flame installations.



C7012 is not affected in any way by a hot refractory.



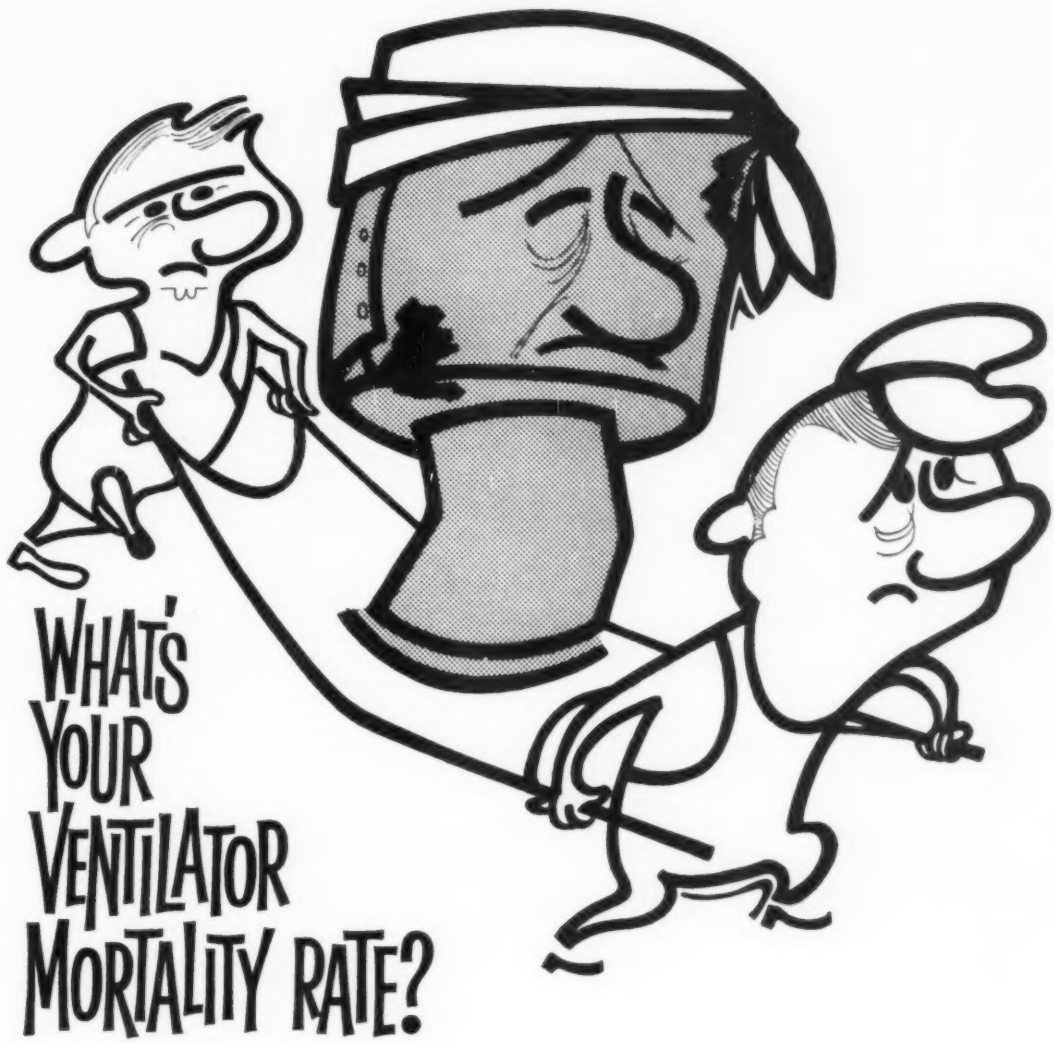
With Honeywell's new C7012, multiple burner installations can be monitored safely for the first time.

FOR MORE DETAILS, CALL YOUR LOCAL HONEYWELL OFFICE, OR WRITE TO HONEYWELL, MINNEAPOLIS 8, MINNESOTA; PHILADELPHIA 44, PENNSYLVANIA; OR TORONTO 17, ONTARIO

Honeywell

First in Control

76-4988 Printed in U.S.A.



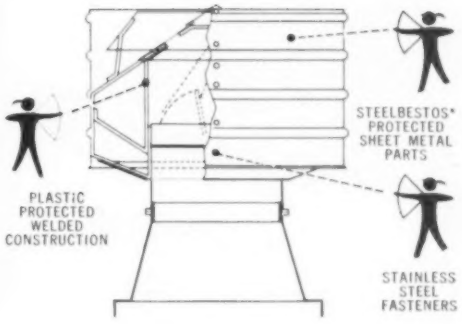
WHAT'S YOUR VENTILATOR MORTALITY RATE?

BOWMAN VENTILATORS HAVE 3-WAY LASTING PROTECTION

Specify and use the ventilator line that is job-engineered to give long years of maintenance-free performance. Bowman's *3-Way Lasting Protection* is available on the complete line of ventilators and louvers:

- Round Gravity
- Continuous Ridge
- Round Power
- Automatic Power
- Axial-Flow
- Louvair
- Industrial Louvers

Technical Bulletins describing each of the above in detail are available on request. Write today!

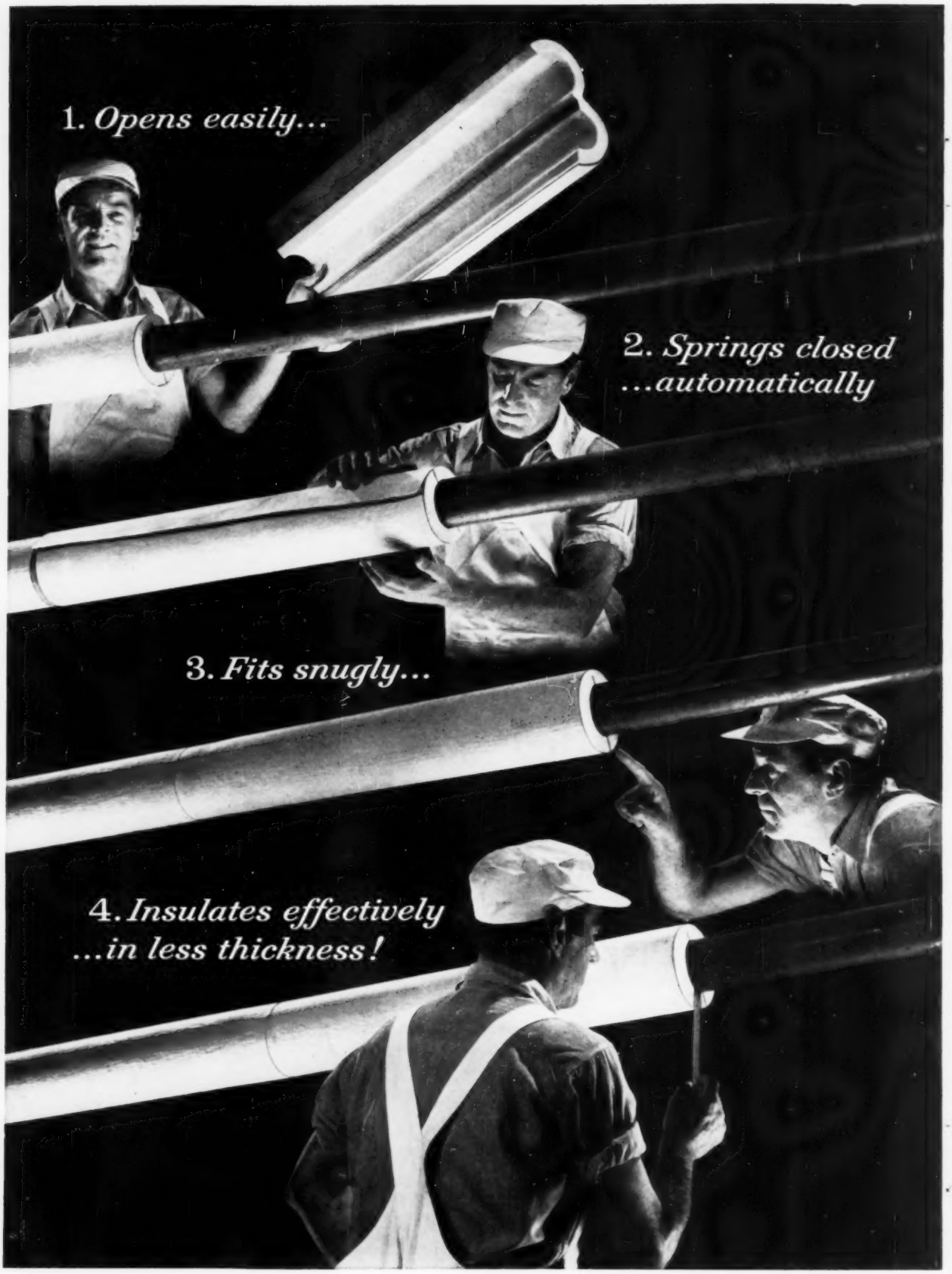


BOWMAN STEEL CORPORATION

Industrial and Commercial Ventilators

P. O. Box 2129 Pittsburgh 30, Pa.

*Bowman Steelbestos is a patented fire-resistant asphalt-asbestos protective coating applied to a galvanized steel core that prevents rust or corrosion in any atmospheric condition. It is approved by both the Underwriters' Laboratories and Associated Factory Mutual Fire Insurance Companies.


1. Opens easily...
2. Springs closed ...automatically
3. Fits snugly...
4. Insulates effectively ...in less thickness!

Works 4 ways to keep costs low!

Micro-Lok...new Johns-Manville fiber glass pipe insulation saves hours on the job . . . saves fuel and power costs

No pipe insulation does more than Micro-Lok to save installation time and keep insulation costs low!

Micro-Lok opens easily, springs closed automatically because it has full-length "spring-hinge" action in each section. The hinge actually runs the full length of each section. This, plus its one-piece construction, saves on installation costs in many ways. It helps free workers' hands more quickly for sealing tabs and other operations, contributing to over-all efficiency.

Micro-Lok is the first pipe insulation made of fiber glass which was developed for easy cutting and fitting of the inside diameter around joints and fittings, pipe hangers and other irregularities.

Micro-Lok is available in standard wall thicknesses . . . especially ½" and ¾" . . . for all pipe and copper tubing sizes. The insulation is offered in a choice of factory-applied jackets including canvas, vapor-barrier and flame-resistant . . . to cover a wide range of operating conditions.

For further information on sizes, thicknesses and applications, contact your nearby Johns-Manville representative. Or write to Johns-Manville, Box 14, New York 16, N.Y. In Canada, Port Credit, Ont.

JOHNS-MANVILLE
Fiber Glass

JOHNS MANVILLE JM PRODUCTS

How Micro-Lok speeds application—improves temperature control—saves fuel dollars

"Spring-Hinge" Action. Easy, full-length opening . . . automatic closing . . . and one-piece construction increase worker efficiency.

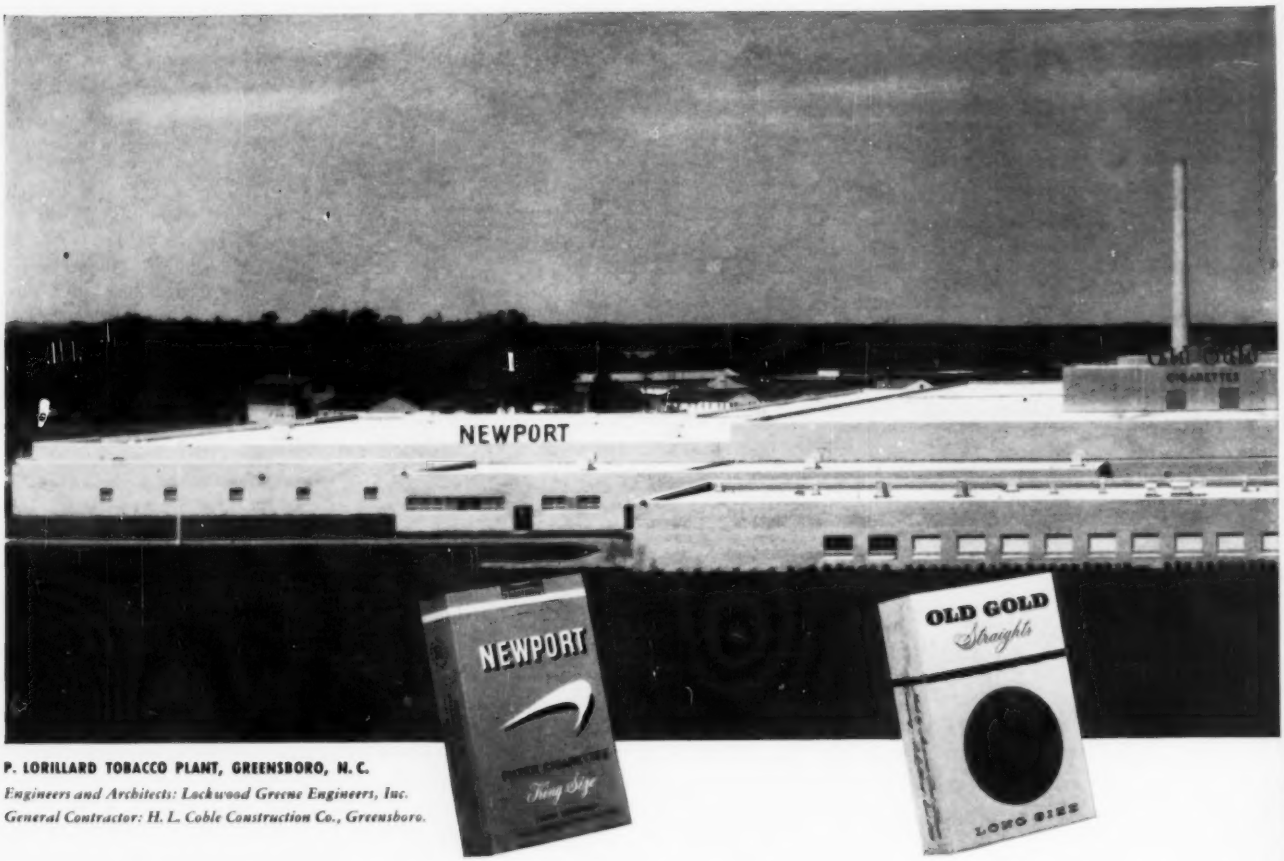
Light Weight. Weighs only a fraction as much as other materials . . . yet does a more effective insulating job.

Resists Abuse. Resilient Micro-Lok won't break, crush or crumble during shipment or application. The material is pleasant to handle, too.

Snug Fit. Accurate molding of inside diameters and knitting of fibers at joints provide a tight seal.

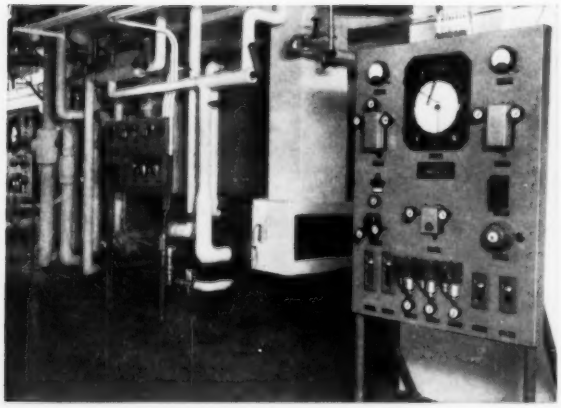
Superior Thermal Performance. Its finer, longer fibers create countless heat-trapping air spaces . . . surpassing the efficiency of many commonly used materials and permitting more effective temperature control. For still greater efficiency—a unique manufacturing process gives Micro-Lok uniform insulating performance throughout the section. Temperature limit 350F . . . to sub-zero.

Moisture Resistant. Inorganic glass fibers are noncellular . . . do not absorb moisture . . . won't rot, shrink or swell. They're noncombustible, too.

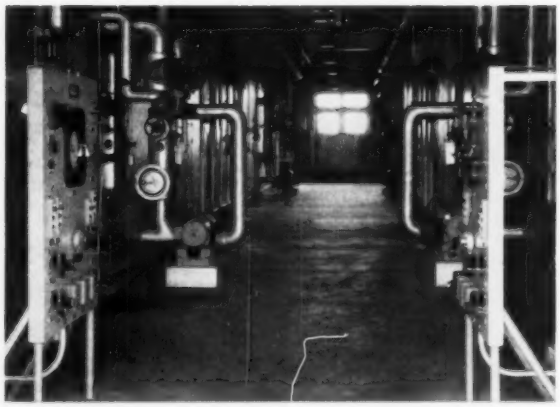


P. LORILLARD TOBACCO PLANT, GREENSBORO, N. C.
Engineers and Architects: Lockwood Greene Engineers, Inc.
General Contractor: H. L. Coble Construction Co., Greensboro.

Cool smoking by P. Lorillard . . .



For offices and laboratories. FULSCOPE Dew-point Controls for the Buensod-Stacey air conditioning equipment for front office area and laboratories. Each of three zones has its own control panel.



For production areas. One of two similar Fan Houses, showing the air conditioning controls for one section of the production area where cigarette machines are located. Each Fan House is equipped with four panel boards.

Taylor Instruments

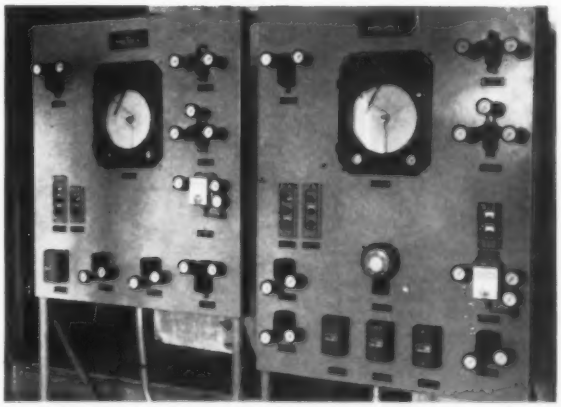
air conditioning controls by Taylor

Every 8-hour shift, millions of cigarettes are produced at the P. Lorillard Co's plant at Greensboro, North Carolina, the most modern cigarette factory in the world.

In the tobacco processing areas, in cigarette production departments and in their offices and laboratories, P. Lorillard consider air conditioning of vital importance. This means dependable, precision control of temperature and humidity within very close limits.

For their Buensod-Stacey air conditioning system Taylor instruments were chosen for several reasons: the fast speed of response of the thermal systems; the long-lived dependability of FULSCOPE* Controllers; their low maintenance costs after installation.

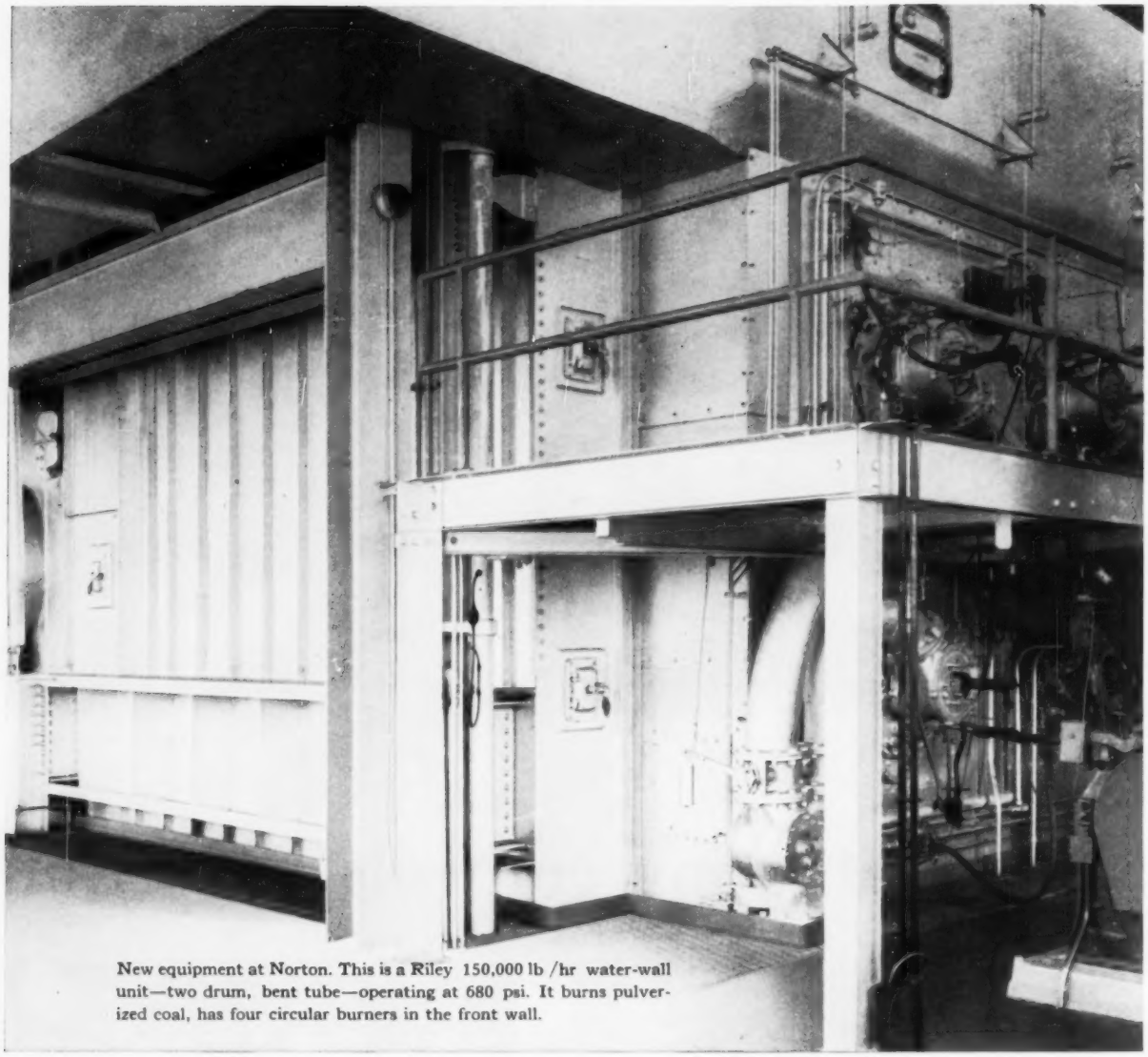
Whether you are conditioning air for product processing or human comfort, (P. Lorillard does both), it will pay you to call in your Taylor Field Engineer. Or write Taylor Instrument Companies, Rochester, N.Y., or Toronto, Ont.



For processing areas. Two of five of the Buensod-Stacey air conditioning panels located in No. 4 Fan House. Taylor FULSCOPE Recording Controllers regulate temperature and humidity in tobacco processing areas.

*Reg. U.S. Pat. Off.

MEAN ACCURACY FIRST



New equipment at Norton. This is a Riley 150,000 lb /hr water-wall unit—two drum, bent tube—operating at 680 psi. It burns pulverized coal, has four circular burners in the front wall.

Coal proves best dollar

NORTON COMPANY FINDS COAL STILL IS LOWEST COST

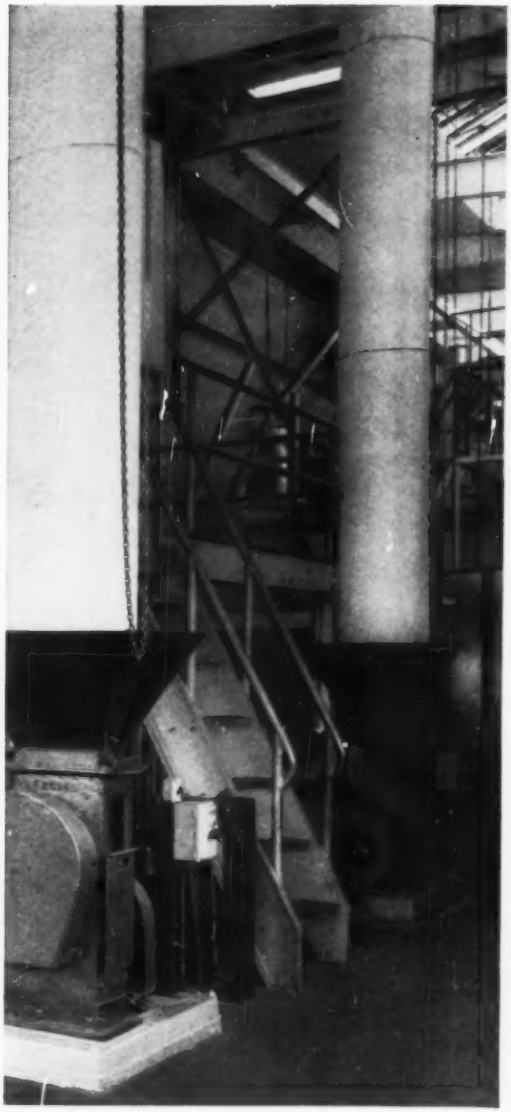
As plant facilities expanded, the Norton Company, Worcester, Mass., world's largest manufacturer of abrasive products, required greater quantities of steam for heating, hot water, electricity and process work. This expansion prompted an engineering survey to determine future power needs. As a result, Norton staff engineers—working with K. R. Warrington, Consulting Engineers—decided to install additional steam generating equipment. Coal had been used previously because it was the most economical of the fuels in that area when the original plant was installed. Coal *continues* as the fuel of the new plant for the same reason. Norton management is sold on the fact that, dollar for dollar, coal is the best fuel buy.

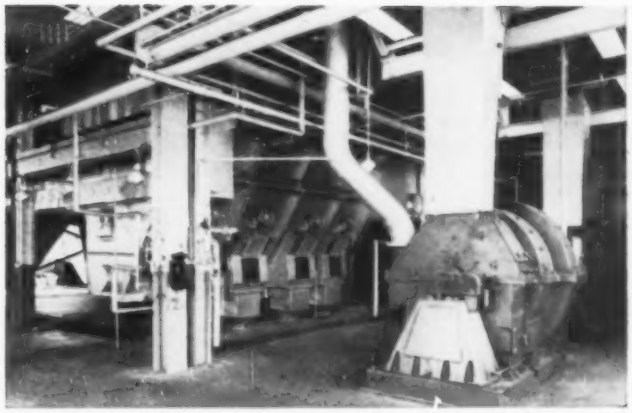
COAL IS LOWEST COST FUEL

Today, *when the annual cost of fuel often equals the original cost of the boilers,* you should know that bituminous coal is the lowest cost fuel in most industrial areas. And modern coal-burning equipment gives you 15% to 50% more steam per dollar, while automatic operation trims labor costs and eliminates smoke problems. What's more, tremendous coal reserves and mechanized mining procedures assure you a constantly plentiful supply of coal at stable prices.

CONSULT AN ENGINEERING FIRM

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel





In the center, ash hoppers—part of United Conveyor steam vacuum ash handling system—lead to underground conveyor which moves ashes to outside storage silo. At right: coal pulverizers.

From track hopper, 100 ton/hr boom conveyor (right) carries coal to storage area. Bucket conveyor (center) lifts it to belt conveyor at top of plant. Coal handling system by William T. Donovan Co. and Jeffrey Manufacturing Co.

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To help you with fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to address below or send coupon. Ask also for case histories booklet, complete with data sheets. You'll find them informative.

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- ☐ GS-2 (high-pressure heating and/or process plant, ram-type underfeed stoker).
- ☐ GS-3 (automatic package boiler for heating and process plants).
- ☐ Case histories on larger plants.

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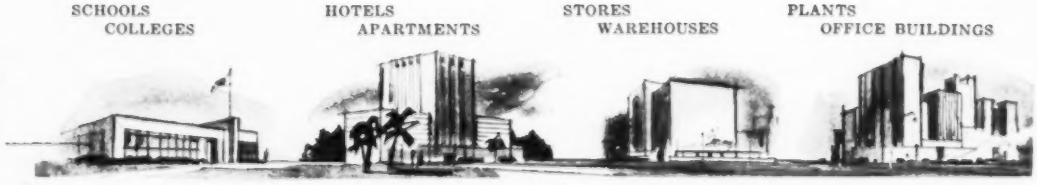
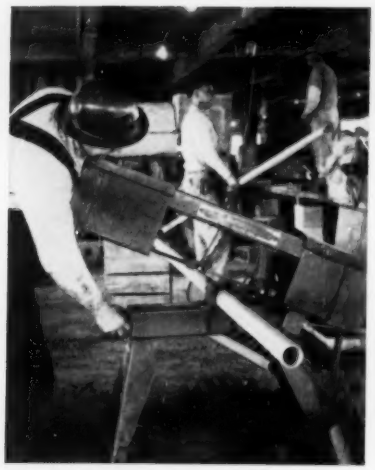


HOSPITALS
INSTITUTIONS



Bethlehem Steel Pipe works easily, installs fast. Beth-Co-Weld is furnished, black or galvanized, in sizes from ⅛ to 4 in., nominal, and in uniform 21-ft lengths, ± 1-in., and in random or cut lengths. We produce larger diameters as Electric Resistance-Weld Steel Pipe.

BETH-CO-WELD in BOSTON

Long-Term Steel Pipe Service for New Travelers Insurance Building

Architect: Kahn & Jacobs, New York. *General Contractor:* George A. Fuller, Boston. *Plumbing Contractor:* Crane Plumbing and Heating Co., Cambridge, Mass. *Pipe Jobber:* Charles D. Sheehy, Inc., South Boston.

THE Travelers people practice what they preach. Their new 16-story office building is well protected against fire by a network of sprinkler and fire lines. But this is their *real* insurance: the lines are fabricated from Beth-Co-Weld and Bethlehem Electric Resistance-Weld Steel Pipe.

Vent and drain lines, too, are steel pipe made by Bethlehem—some galvanized and furnished in extra-long 23-ft, 2-in. lengths which, cut in half, run the full 11-ft, 7-in. story height. Travelers found true economy in Bethlehem Steel Pipe.

In any building, durable, low-cost steel pipe is a sound choice. On your next job, use Beth-Co-Weld and Bethlehem Electric Resistance-Weld—Steel Pipe at its best.

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Heating Piping & Air Conditioning

December 1959

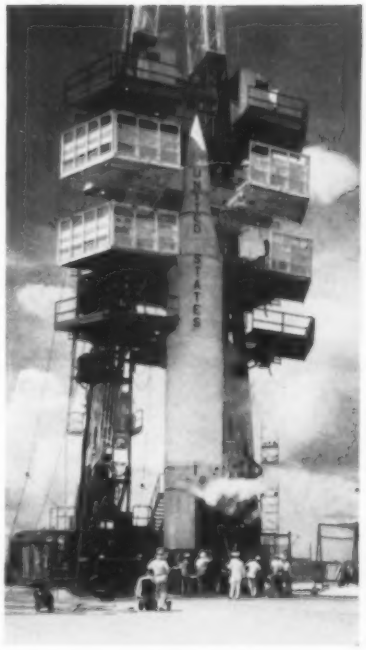
You'll Want To Know...

For news of new products, see the Equipment Developments department in this issue, and for new catalogs, bulletins, etc., see the Recent Trade Literature columns. Other news material also appears in the Who's What and the We Hear That departments. Meetings and Conventions are listed toward the back of this issue under that title, as are New Books and Reports.

Air Force Missile Test Program Depends on Piping, Air Conditioning

THE importance of air conditioning and piping is very evident in the operation of the U. S. Air Force facilities at Cape Canaveral in Florida. The experimental test facilities for missiles at the Cape are all under the operational control of the Air Force. Missiles arriving at Cape Canaveral for test are first taken to an assembly building where most of the component parts are assembled. Also, every circuit and part is checked thoroughly prior to moving it to the launching facility.

The three basic elements in each launching facility are a blockhouse, a launching pad or stand, and the necessary supporting facilities. The blockhouses protect the essential equipment and personnel during the firing and they are designed to resist an assumed explosive force. These blockhouses are all air conditioned to remove the heat generated by the occupants and the large amount of electronic equipment. In each case, five minutes before the firing of a missile the air conditioning system is switched over to 100 percent recirculated air and the outdoor air duct is closed. Air conditioning is also an absolute necessity for cooling the electronic equipment for guiding and tracking the missiles in flight at each



of the 12 stations down the 5000 mile range from Cape Canaveral.

The launching stands vary in complexity depending upon the missile that they are designed to accommodate. In all cases, water piping, instrumentation, and power are needed. Provisions for liquid oxygen, JP-4 (Kerosene), and other liquid fuels are also included for some missiles. In addi-

tion to this, piping for liquid nitrogen, gaseous nitrogen, helium, and compressed air is required for many launching pads.

As much as 36,000 gpm of water are used for removing the heat received by the flame deflectors in a launching stand such as for the Atlas missile. A water jacket encloses most of the flame deflector, and the jacket water is forced through a carefully designed pattern of orifices in the deflector for external cooling. Most of the water is converted to steam, and the remainder flows over the face of the steel plate removing the excess heat.

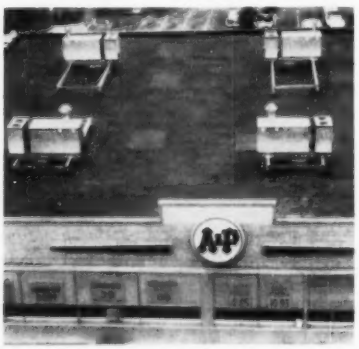
To provide fire protection and to meet the hazards of the missile fuels, another water system with a high water demand from 10 to 20,000 gpm must be capable of delivery within a few seconds after activation of the system. This fire protection system, in most cases, is designed to operate at the same time as the flame coolant system. The water is delivered through fog nozzles, and deluge nozzles supplement these so the burning mixture of fuel and oxidizers can be washed away in a matter of minutes. Both of these systems are remotely controlled from the blockhouse. Storage requirements are not excessive for these systems because the period of use is relatively short. Most fires have been controlled in less than 15 minutes, and the major part of the demand which is for cooling the deflectors is usually required for less than 2 minutes. Surge relief valves and air cushioned surge chambers have been incorporated in the water piping systems to reduce the possibility of water hammer occurring.

One of the major problems in meeting construction schedules is the special fabrication of piping, tanks, and other equipment required for storage and handling of liquefied and compressed gases. Much of this equipment is almost as experimental as the missiles. Liquid oxygen and liquid nitrogen are required for many of the missiles. Stainless steel tanks which are double-jacketed are used to reduce contamination and evaporation losses. The annular space in the tank is evacuated to a high vacuum to increase the insulating effect. Because of the strong tendency of the liquefied gases to cavitate in pumps, valves, and orifices, and because of the large degree of contraction in the piping, additional problems are created.

The piping systems handling the missile fuels and liquid oxygen must be absolutely clean because any small particle of hydrocarbon or other matter capable of burning may explode in the presence of liquid oxygen. Another requirement for cleanliness of these piping systems is dictated by the delicacy of the missile valves and the need to pass the liquids and gases through minute orifices.

The stainless steel pipe and fittings are cleaned first with steel brushes and then flushed with a degreasing agent. This is followed by "pickling" the interior of the pipe with a solution of nitric and hydrofluoric acid. This is then flushed out with mineral-free water. Finally, the pipe and fittings are dried out with clean and dry nitrogen. Ultraviolet light examination of the metal surfaces or examination of filter paper wiped over the metal are the two inspection methods used. During assembly of the system, special pipeline filters are installed and these are inspected periodically by microscope as a constant check on the purity of the system.

To maintain pressurization of various components of the missile, various inert gases such as helium, nitrogen, and air are used. Most of the piping for handling these gases is designed for 6000 psi. These systems include compressors, driers, purifiers, controls, and the extra heavy pipe and fittings leading to the test stand.



Rooftop Units Supply Supermarket Heating, Air Conditioning Needs

AIR CONDITIONING AND HEATING a new one story A & P supermarket in New York City presented several problems, according to Ventil-Aire Corp. First, the owners did not wish to lose any selling or basement storage area to the installation. In addition, they did not want store operations interrupted while the system was being installed.

These problems were solved by installing packaged rooftop air conditioning and heating units. A total sales floor area of 10,000 sq ft is served by four 7½ ton units. Placed forward near the checkout area were two units, each with a 250,000 Btu per hr capacity, and at the rear are two more units, each with a 200,000 Btu per hr capacity. The four units can, at full load condition, each handle about a fourth of the sales area.

The units did not require additional roof supports, since they were installed directly on the structural beams. The entire installation required only three days.

HPAC Directory Section Coming in January

THE JANUARY HPAC will contain the 26th annual Directory Section of Heating, Piping and Air Conditioning Equipment for Industrial, Commercial, Institutional, and Public Buildings.

Thoroughly revised and up to date, the 1960 Directory contains complete manufacturers' addresses, and an additional product classification of all equipment on which information is given in the advertising pages of the same issue.

Consulting Engineers Council Attacks "Free" Engineering

. . . at semi-annual meeting

BOTH progress and perplexion were in evidence as the U.S. Consulting Engineers Council board of directors met November 5 through 8 in Cincinnati.

The practice of engineers stamping so-called "package" or "standardized" designs prepared by manufacturers was attacked by C.E.C. ethics committee chairman, Joe Williamson of St. Louis. According to Mr. Williamson, 100 percent packaged engineering jobs are finding increased acceptance. Admitting that packaged systems are perhaps an advance, Mr. Williamson took exception to the practice of engineers charging full fees for such systems.

The progress of the Consulting Engineers Council was demonstrated repeatedly in committee and special reports covering subjects ranging from community development to office practice. Documents committee co-chairman, George W. Poulsen of Salt Lake City, presented outlines of 11 C.E.C. documents scheduled for publication prior to January 1, 1960. Included were architect-engineer and engineer-client agreement forms, legal and procedural documents and bonds, and mechanical-electrical special conditions.

A complete delineation of the elements which constitute cost in the operation of a consulting office were outlined in a progress report submitted by office practice committee chairman, Cedric Acheson of Syracuse.

Organized only three years ago, C.E.C. is made up of 27 state or regional associations of consulting engineers. Pennsylvania, Indiana, and Kentucky are the newest members, receiving acceptance at the Cincinnati meeting. Represented in the C.E.C. are approximately 1000 consulting engineering firms serving many fields.

The purpose of the C.E.C. is to improve the economic and professional well-being of consulting engineers and this is being accomplished in many ways. One is the plan to publish a number of brochures on such subjects as "How to Select a Consulting Engineer", "Establishing A Fee", and the advantages of "Private vs. Public Engineering".

C.E.C. president, Ralph Westcott, of Los Angeles, announced at Cincinnati that the council has been requested to furnish detailed information on why it is more economical and efficient for federal agencies to utilize private engineering talent. All members of the Board of Directors were urgently requested by Mr. Westcott to provide specific facts on this subject.

The results of a survey of 71 U.S. air conditioning and heating equipment manufacturers were reported by Council Executive Secretary, Larry N. Spiller. Firms included in the poll were asked to indicate from 56 major U.S. distribution centers the names of local agents, and whether or not such agents performed design engineering. Quoting from a number of replies, Mr. Spiller indicated there is a growing awareness among manufacturers of the consultants' feelings with regard to agent-design competition. Many companies expressed their intention to prohibit such activity.

A policy statement adopted by the C.E.C. Board on the subject of "Free Engineering" states:

"Charges for professional engineering services should be fully and separately proposed, quoted and invoiced by persons or firms who furnish the services. It is unethical and unprofessional to conceal, lump together, or absorb any part or all of the cost of professional engineering services in the cost of equipment, materials, construction, or non-professional services."

Tiring of being placed on the defensive by government statements relative to so-called "high cost" of consulting services, the Board of Directors recommended that C.E.C. officially challenge statements by the U.S. Comptroller General that cost-plus-percentage contracts "create an incentive for the consultant to carelessly or deliberately increase direct costs, thereby proportionately increasing reimbursements for overhead, contingencies, and fees."

Among other subjects covered by the C.E.C. Directors were corporate practice, professional liability, progress payments, standardization of federal experience data forms, and possible action to promote legislation in connection with the wage hour law.

John F. Hennessy, Sr., New York City, reported on C.E.C. participation on the EJC-AIA joint committee. Subjects being studied by the committee include: (1) professional liability, (2) division of responsibility, (3) local collaboration, (4) fees, and (5) legislation.

The next meeting will be May 4-7, 1960, in Portland, Ore.

CONSULTING ENGINEERS COUNCIL Board of Directors representing 27 state or regional associations met last month in Cincinnati to discuss objectives of the three year old organization

New Manhattan Apartments to Have Central Cooling

A FASHIONABLE NEW COOPERATIVE apartment building is being erected at 700 Park Avenue in New York City. According to Tishman Realty & Construction Co., Inc., the 20 story building will have six-to-ten room apartments.

The building will have a central refrigeration plant which will filter and dehumidify outdoor air before it is distributed throughout the building. Each of the 48 apartments will have individual controls.

U. S. Bureau of Mines Issues Burner Oil Report

A SURVEY OF BURNER OIL properties in use in the United States has been completed by the U. S. Dept. of Interior's Bureau of Mines. The report was made at the request of the Technical Division of Oil Heat Institute and conducted under a cooperative agreement with the American Petroleum Institute and the Bureau of Mines. Information contained in the survey was compiled from data supplied by 44 petroleum refining companies and 117 refineries throughout the U. S.

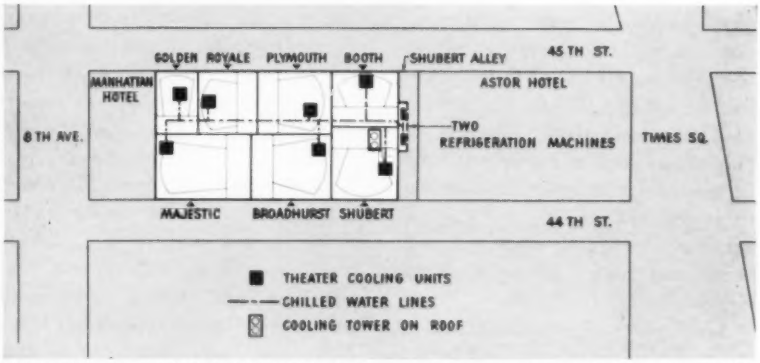
Published copies of the report may be obtained by writing the Bureau of Mines, Pittsburgh, Pa.

ARI Unitary Shipments Up 39 Percent

UNITARY AIR CONDITIONER shipments are up 39 percent for the first six months of 1959 over the same period in 1958, according to figures released by the Air-Conditioning and Refrigeration Institute.

The ARI report, summarized in tabular form according to rating classifications from 18,000 to 380,000 Btu/hr and over, shows that the largest single increase in unitary shipments was in the 42,000 to 53,999 Btu/hr classification which is up 106 percent over 1958. Total shipments amounted to 160,791 units for the period reported.

Central Air Conditioning To Serve New York Theaters



CENTRAL AIR CONDITIONING hook-up which will serve Manhattan's Golden, Royale, Plymouth, Booth, Majestic, Broadhurst, and Shubert theaters is shown above. The location of each of the individual theater's cooling units is shown as well as the system's cooling tower, which is on the roof of the Shubert theater. The entire 650 ton central air conditioning system is in an unused boiler room beneath Shubert Alley

A MASTER AIR CONDITIONING system which will serve nearly one quarter of New York's legitimate theater district will be operated for the first time next year, according to Worthington Corp. The system will serve the Shubert, Broadhurst, Majestic, Booth, Plymouth, Royale, and Golden theaters.

Until the central refrigeration plant was installed in an unused boiler room beneath Shubert Alley, each of the seven theaters depended on a chilling system of air blown over 350 lb blocks of ice. In addition to the saving in operational cost, the use of the 650 ton central air conditioning system will permit humidity control and the other advantages of air conditioning.

The theater's total of 7999 seats make this installation the largest single theatrical air conditioning system ever devised. During installation of

the system, which is due to be turned on by next spring, the theaters will continue in operation.

Though the ice system was outmoded, most New York theaters were closed during the summer months and so it was not practical to install mechanical cooling.

J. J. Shubert, owner of the theaters, pointed out that important changes in the nature of the legitimate theater business have made the air conditioning project, which would have been a gamble a few years ago, a necessity today. He cited two factors which have changed the theater into a year 'round business and made provisions for summer comfort of patrons a must.

First, the growth of mail order advance sales and, second, the increasing number of theater parties account for the increase in summer business from five percent to 40 percent of profits over the past 10 years.

The new air conditioning system will pipe chilled water from the central system to cooling units in the individual theaters. Pumps will circulate the chilled water to the cooling systems in the theaters and other pumps will deliver condenser water to the evaporation tower which will be constructed on top of the Shubert theater.

There will be a constant water flow through the cooling system and the compressors will be able to operate at varying speeds in order to meet load requirements. Outside temperature changes and varying numbers of persons will cause automatic adjustments of the system to maintain constant comfort for the occupants.

H. J. Scharres, First Engineer Named to Chicago Landmark Commission

HARRY J. SCHARRES has been named to the Commission on Chicago Architectural Landmarks. He is the first engineer appointed to the commission, whose purpose is preserving and publicizing Chicago's building accomplishments.

Chicago has made many important contributions to engineering and architectural development. Its Monadnock building helped usher in the "skyscraper" era in American architecture and Chicago's Auditorium Theater (which has housed up to 8000 people) has an air conditioning system which is essentially the same as what would be done in a comparable building today—although the system was installed at the time the building was constructed in 1890.

Mr. Scharres is a practicing consulting engineer and partner in the firm of E. R. Gritschke & Associates. His appointment was made official on October 19, 1959 by Mayor Richard J. Daley after his candidacy for membership on the commission had been approved by the Chicago City Council.

ARI To Certify Unitary Heat Pumps

THE AIR-CONDITIONING and Refrigeration Institute announced inauguration of a certification program for unitary heat pumps much as it now has for unitary air conditioners.

When underway, the certification program will provide for testing and rating by manufacturers and reporting ratings to ARI, as well as publication of ratings in the ARI directory. It is hoped that the certification program will become effective no later than January 1, 1961.

The ARI also announced that the final 1959 issue of its *Directory of Certified Unitary Air-Conditioners* is now being prepared.

U. S. Construction to Set New Record in 1960

U. S. CONSTRUCTION investments are expected to exceed $55 billion during 1960, according to Architectural Forum magazine. This figure represents a 1.5 percent rise over 1959. However, the 1959 total of an estimated $54.9 billion is 11.8 percent above 1958 and three and one half times the average increase of the past few years. 1960 will be the sixteenth year in a row that construction activity has expanded.

Nonresidential building, including privately financed office buildings, warehouses, stores, restaurants and garages comprise a total 1960 anticipated investment of $4.3 billion. This is an increase of 7.6 percent. Public building in this nonresidential commercial category would raise the total to $4.6 billion.

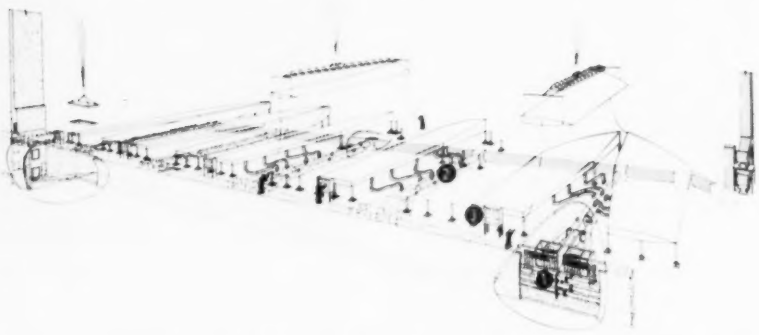
The highest single nonresidential increase will be in the industrial area where $2.7 billion will represent a 17 percent jump.

Ventilate Motor Room With Large Air Flow Rate

FANS AND FILTER equipment to ventilate 12 main stand motors and two large motor-generator sets have been installed at the Campbell Works of Youngstown Sheet and Tube Co. as a part of a modernization program, according to the Sturtevant Div. of Westinghouse Electric Corp.

Redesign of three 20 ft bays of roof area will permit the supply air system to be enclosed within it. Twelve vertically mounted vaneaxial fans will draw 825,000 cfm of air through filters and deliver it to the main motor room. Seven basement located centrifugal fans will draw approximately 630,000 cfm through the motors and generators. Total connected horepower to the fans will be 1515 hp.

How Underground Air Conditioning Aids Bomber Production



The drawing above shows the system design. Outdoor air is supplied to the system from the intake at the left. After circulating through the wings, the air is exhausted through the unit at the extreme right in the drawing. The numbered areas are: (1) piping for the water supply. Directly above the numeral are the thermal units which heat or cool the air and water going into the system (2) the two large intake ducts feeding in and the center duct which ties into the exhaust system, and (3) individual control panels for each wing section

AN UNDERGROUND AIR CONDITIONING and heating system plays a vital role in the production of B-52G bombers, according to the Trane Co. The system is located under a plant wing sealing area in the Boeing Airplane Company's Wichita, Kansas, Div.

The B-52G (see *Design Jet Bomber Environment for Wide Temperature, Pressure Extremes*, pp. 102-105, Sept. 1959 Heating, Piping & Air Conditioning) is a missile platform bomber used by the Strategic Air Command. It is distinguished from its predecessors by the fact that the 185 ft integral wing is a fuel tank in itself. For this reason, the wings have to be leakproof.

Each rivet and bolt used in wing construction must be sealed over inside the wing with plastic sealant. Crews apply sealant inside the 80 ft wing sections and then cure the sealant rapidly before the wing can be joined to the fuselage. The fumes and heat generated from these operations create practically unbearable conditions inside the wing. Therefore, it was necessary to provide an air conditioning system capable not only of air conditioning each wing section, but also providing water and heat.

The specific requirements for the system include the ability to:

1) Maintain comfortable temperatures (about 72 F) inside wing sections to which crews apply sealant

2) Provide constantly circulating outdoor air to eliminate toxic fumes given off by cleaning agents used in sealing and ammonia fumes employed in testing

3) Supply ventilation for cleaning wing interiors after leak tests

4) Allow heating of individual sections and control of humidity in curing the plastic sealant after application. This requires temperatures up to 140 F with humidity levels from 1 to 100 percent.

The area where the sealing and curing operation takes place is 90 × 300 ft. Ten of the wing sections, or five pairs, are in various stages of sealing and curing at all times.

When it was decided to install an underground system of tunnels, piping, and ductwork with individual hookups and controls for each wing, crews first excavated to an overall depth of 4 ft, then dug 8 ft deep tunnels on both sides of the hole's 300 ft length.

The tunnel on one side connects to intake fans to draw in outdoor air. The 80 ft lines feed off the tunnel, running parallel to each of the wing sections. At the tunnel connection point, each line has a combination unit for cooling or heating the incoming air. Heat transfer within the units is provided by water coils.

Outdoor air is driven through the tunnel by two fans at a rate of 80,000 cfm at a pressure of 11.5 in. water gage. Heating or cooling each wing section is regulated by 10 master control units above the surface.

The other 300 ft tunnel has five 80 ft lines attached to it, each serving two wing sections. Contaminated air is continually drawn from the wing sections into the main tunnel by two exhaust fans. This air is then exhausted outside the plant high above roof-top level.

1960 Predicted Good Year for Business

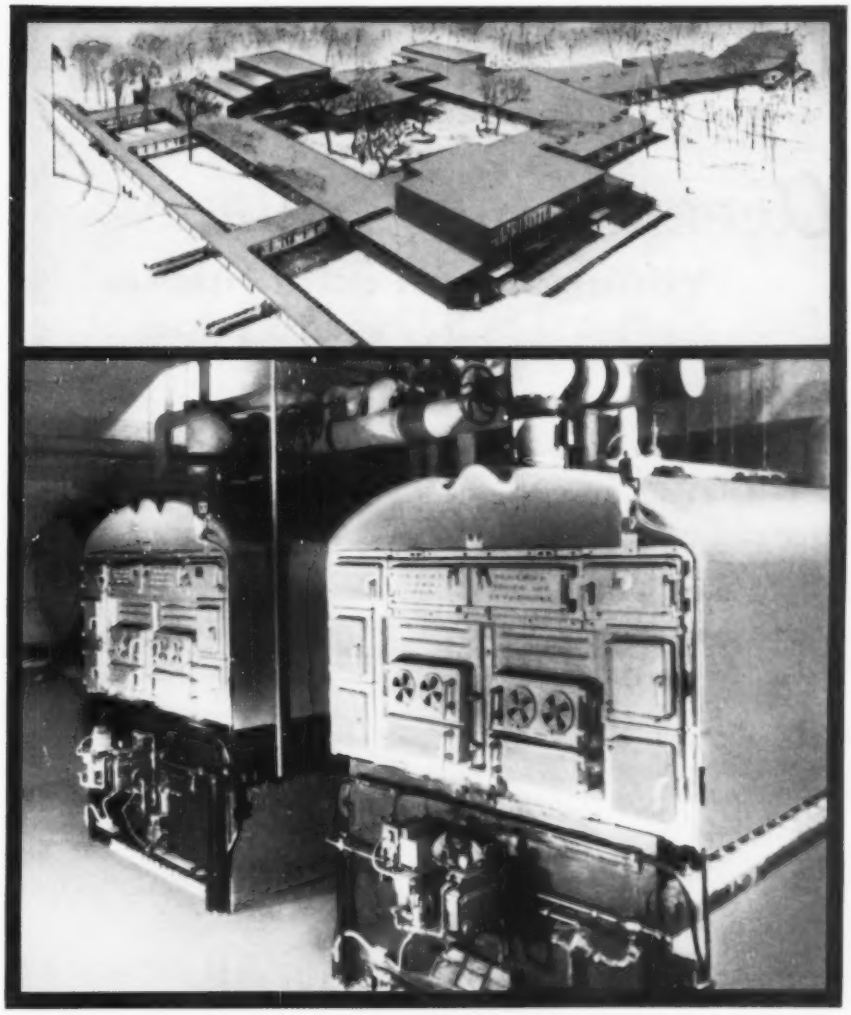
THE 1960 BUSINESS OUTLOOK reflects a spirit of cautious optimism, according to the annual survey of F. W. Dodge Corp. However, the survey of 273 of the nation's economists in business, government, and universities also predicts that 1960 will be a record-breaking year in most respects.

The average expectation of economists participating in the survey was that gross national product will reach an annual rate of $514 billion by the fourth quarter of 1960, a gain of 6 percent over the mid-1959 level. The Federal Reserve index of industrial production is expected to rise 3 percent from the mid-1959 level, reaching 160 by the end of next year. Over the same period, wholesale and consumer prices are estimated at 1 to 2 percent higher.

The basis for all these estimates repeatedly stressed in the survey was a lasting settlement of serious labor difficulties.

Half Hollow Hills High School, Huntington, L. I., N. Y. Architect: Daniel Perry, Port Jefferson, L. I., N. Y. Consulting Engineers: Gussow & Skidmore, New York, N. Y. Heating Contractor: Hassett Heating & Fuel Oil Co., Huntington, L .I., N. Y.

Multi-System Heating Installation Centers on Two H. B. Smith Boilers



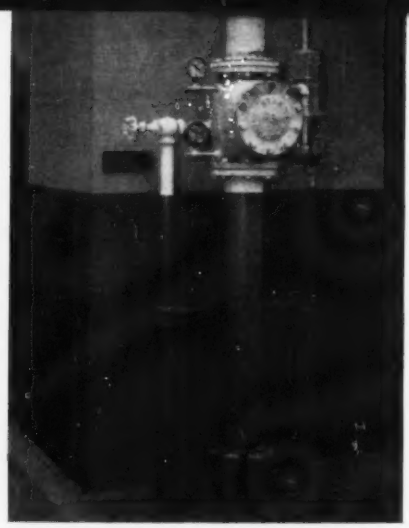
These two H. B. Smith No. 60-W-24 boilers heat the classroom area, 75% of the 103,563 sq. ft. total floor area.

The daring, yet highly functional design of the Half Hollow Hills High School, Huntington, L. I., N. Y., posed some interesting problems to the heating engineer. The school's extended floor plan, exposed fluted steel roof deck ceiling, floor-to-ceiling glass outside walls and thermal lag of the floor slab precluded any single method of heating. Three-fourths of the load is carried by an appropriately zoned, forced hot water system with two H. B. Smith No. 60-W-24 boilers using unheated No. 5 oil. The remainder of the school is heated by forced warm air and unit heaters.

H. B. Smith Cast Iron Water Tube Boilers excel in school and comparable installations. Their moderate initial cost, high efficiency, economy of operation and unusually long trouble-free service life enable them to provide heat and ample domestic hot water at the *lowest cost per year.*

H.B. Smith **CAST IRON BOILERS**

THE H. B. SMITH COMPANY, INC., WESTFIELD, MASSACHUSETTS • Est. 1853



Automatic Sprinkler—Fire Protection Main Supply Riser in Janitrol plant. **Architect-Engineer:** Lehman-Gerstner & Associates, Columbus, Ohio. **Installing Contractors:** Star Equipment Co., Columbus, Ohio.

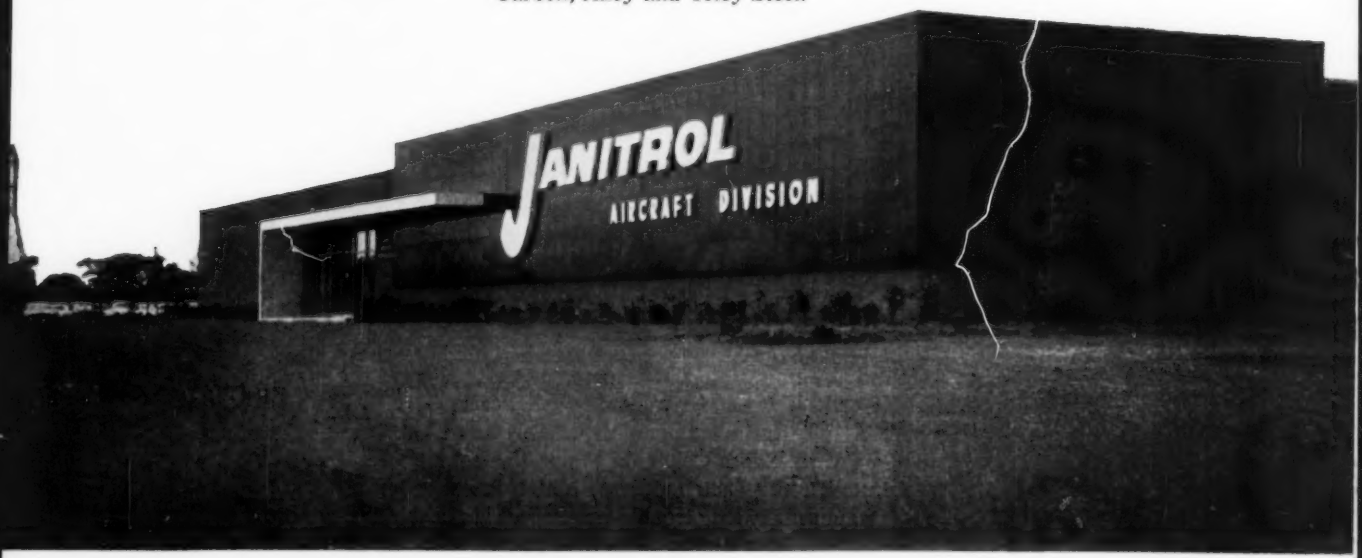
Accent on Excellence

Youngstown continuous weld pipe

Elaborate, highly specialized fire protection systems are a must for aircraft-missile component manufacturers. A case in point: Janitrol Aircraft Division, Surface Combustion Corporation.

At Janitrol's new Columbus, Ohio plant, over 14,000 feet of Youngstown Continuous Weld Pipe carries protection to vital test, development and manufacturing facilities. In safety, dependability and economy, this quality pipe met or exceeded the exacting standards set by the underwriters, the architect-engineer, the installer, and the customer.

Wherever you use steel pipe, the high standards of Youngstown *quality*, the personal touch in Youngstown *service* will help you meet job specifications with an "accent on excellence". The Youngstown Sheet and Tube Company, Youngstown, Ohio. Carbon, Alloy and Yoloy Steel.



Youngstown

QUALITY YOUNGSTOWN SERVICE

AIR CONDITIONING and REFRIGERATION SERVICEMEN! DEALERS! CONTRACTORS!

WIN A GEN-U-WINE MOTH-EATEN MOOSEHEAD!

(Extra supply of moths upon demand)

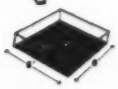
You, by gum, can be the FIRST in your neck of the woods to own this 100% priceless trophy . . .

BUT

If you win it and don't want it, you'll *have to* accept the alternate prize, which is a $500.00 U.S. Savings Bond . . . *much* less exciting from a real connoisseur's point of view.

Anyway, it's *your* decision to make . . . if you enter the big new contest sponsored by Ucon Brand Refrigerants. The moosehead is the first prize. There are 65 (count 'em) 65 other jim dandy awards . . .

5 Second Prizes: A HEADLESS BEARSKIN RUG
(or a $100.00 U.S. Savings Bond)



10 Third Prizes: A 6 X 6 FOOT FROZEN NORTH LAND CLAIM
(or a $50.00 U.S. Savings Bond)

50 Fourth Prizes: A 100-LB. PACKET OF SOURDOUGH
(or a $25.00 U.S. Savings Bond, if you like your dough sweeter)

STAKE YOUR CLAIM NOW . . . HERE'S HOW! First, run like mad down to your nearest Ucon Refrigerant wholesaler. When you've caught your breath, look for Ucon Ike's picture on the special contest display, and whip out an entry blank. Complete the statement on the blank (in eleven words more or less), print your name and address (and the wholesaler's) on the blank . . . drop your entry in the box.

THE WINNING NAMES will be announced shortly after the contest's conclusion. If you're a winner, both you *and* your wholesaler will receive *duplicate* prizes. And even if you don't win one of the frabjous top prizes, you'll get a FREE Ucon Refrigerants Tie Clip—the coolest thing that ever happened to a cravat. We mean, like, *nobody* loses!

CONTEST RULES
(The lawyer says we have to have them)

This contest is open to all air conditioning and refrigeration contractors, dealers and servicemen during the contest period: November 2, 1959 through January 30, 1960. Employees of Union Carbide Chemicals Company, Ansul Chemical Company, their subsidiaries and agencies are not eligible to enter the contest. Ucon Refrigerant wholesalers are also ineligible—*but will be awarded duplicate prizes if their names appear on prize-winning entries.* Winners will be announced by mail within a few weeks following the contest.

UNION CARBIDE product **Ucon** BRAND refrigerants — exclusive sales agent — ANSUL

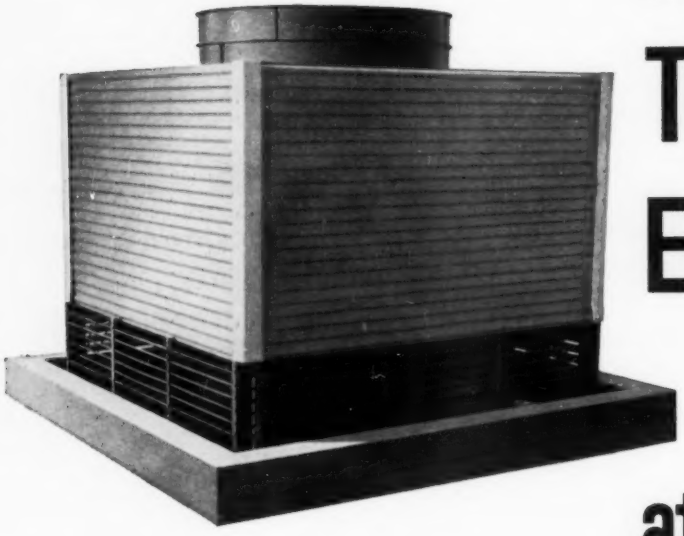
Ucon Brand Refrigerants are manufactured by
UNION CARBIDE CHEMICALS COMPANY—Division of Union Carbide Corporation
30 East 42nd St., New York 17, N. Y.

Exclusive Sales Agent to Air Conditioning and Refrigeration Wholesalers
ANSUL CHEMICAL COMPANY, Marinette, Wisconsin

Ucon and Union Carbide are registered trade marks of Union Carbide Corporation

FLUOR OVER 40 YEARS OF COOLING TOWER EXPERIENCE at your service *

*Since 1919 Fluor has been building cooling towers throughout the world. (An average of one new industrial and commercial cooling tower is erected by Fluor every three days.)



Ask for our brochure FP-131 that shows why Fluor Towers mean more efficient operation.

See our exhibit in Dallas at the 2nd Southwest Heating and Air Conditioning Exposition February First to February Fourth.

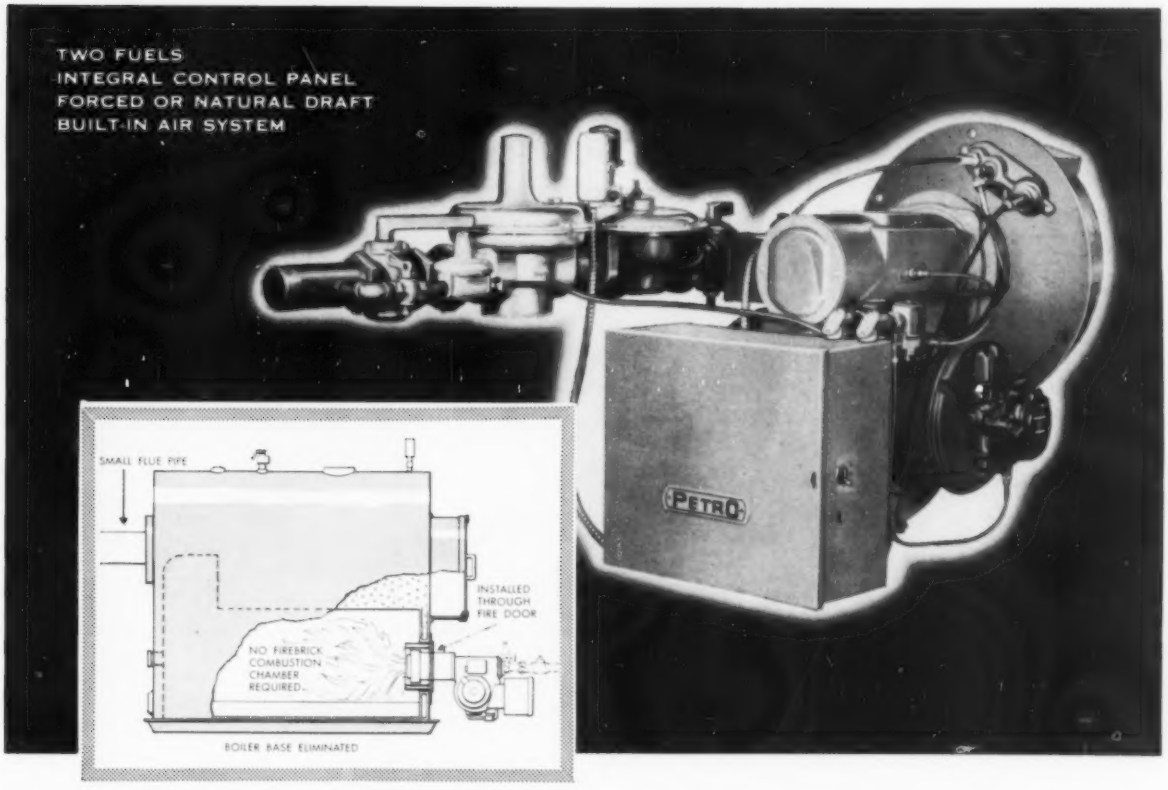
Fluor PRODUCTS COMPANY

AIR CONDITIONING AND REFRIGERATION COOLING TOWERS

A division of The FLUOR CORPORATION, Ltd.

GENERAL OFFICES:
SANTA ROSA, CALIFORNIA

New all-in-one burner *bolts to boiler front*



Average installation saving in firebox boilers: $250

Substantial savings in installation costs are made possible in a firebox boiler by the elimination of the boiler base and fire brick combustion chamber. Fits any boiler; bolts to the boiler front. Complete forced draft, fuel and control systems are built into the burner. No secondary air construction needed.

Also available as boiler-burner unit

Packaged boiler with integral burner can be delivered at site, ready for service connections. No brickwork, pit, or special setting required.

No high stack needed

In a sealed fire box no stack is required; merely a vent. Air is supplied under forced draft. In conventional boilers the stack can be shorter and smaller than required by the usual gas or oil burner.

Switches fuels instantly

Burns either fuel with high efficiency. Saves purchase of extra burner in areas where gas users must provide standby oil equipment. One-fuel models are also available for either gas or oil.

Cuts fuel costs

New type of burner head and improved fuel-air control develops exceptional combustion efficiency. Instant heat absorption. No wasteful refractories to heat up.

Costs less to operate

Requires no more supervision than a domestic burner. Maintenance problems are negligible, and can usually be handled by the janitor.

Capacities: oil, 4 to 30 gph; gas, 500,000 to 4,000,000 btu/h.

Send coupon for full description and specifications

Makers of Quality Heating and Power Equipment since 1903

PETRO

T. M. REG. U. S. PAT. OFF

PETRO, 3335 W. 106th Street, Cleveland 11, Ohio
(In Canada: 80 Ward Street, Toronto, Ontario)

Please send complete information on Petro P-240 dual-fuel burner and boiler-burner units.

Name _____

Company _____

Address _____

City _____ State _____

US RUBBER EXPANSION JOINTS

How to keep your cost accountant contented

Just ask him to amortize the cost of a U.S. Rubber Expansion Joint.

He will have a pleasant time discovering that these joints never seem to wear out. Some have been in use for 30 years and are as sturdy as ever. No other rubber expansion joints have been in use that long.

"U.S." Expansion Joints are the only joints that have withstood this test of time. As for value, "U.S." Expansion Joints remain the cost accountant's delight. Other so-called "just-as-good" joints costing a few dollars less can rob you of many times their complete cost when they cause downtime.

Your accountant will tell you that "U.S." Expansion Joints comprise shrewd, logical insurance. These joints are the economical, flexible connections used in all kinds of pipe lines to take care of misalignment, vibration, expansion, contraction and noise transmission. No moving parts to wear or bind; can be installed on new or old equipment.

• • •

When you think of rubber, think of your "U.S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.

US RUBBER

Mechanical Goods Division

United States Rubber

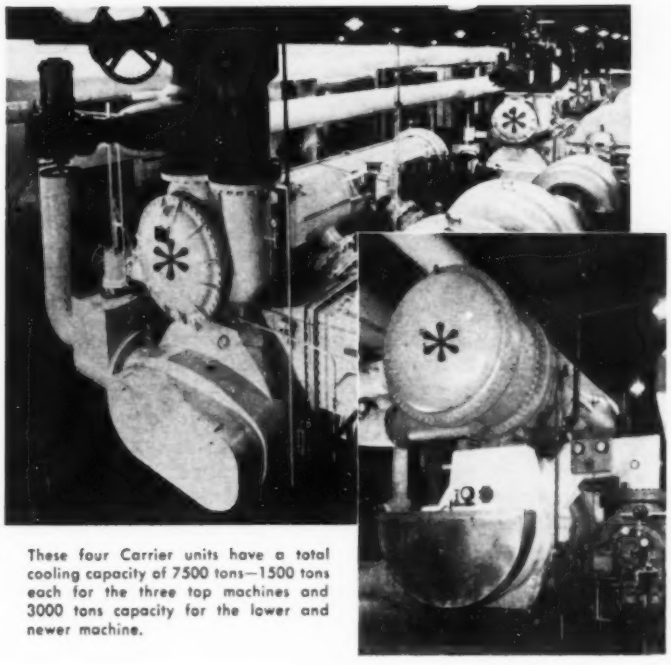
WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

Wolverine Trufin Type S/T.

Gateway Center, Pittsburgh, Pa.

WOLVERINE TRUFIN® TYPE S/T helps Carrier cool GATEWAY CENTER



These four Carrier units have a total cooling capacity of 7500 tons—1500 tons each for the three top machines and 3000 tons capacity for the lower and newer machine.

Carrier engineers have high praise for Wolverine Trufin Type S/T—the integrally finned refrigeration condenser tube. They speak from experience in using Trufin in Centrifugal Refrigeration Machines for air conditioning the buildings of Pittsburgh's beautiful Gateway Center.

"The ability of Trufin Type S/T to pack a lot of heat transfer surface into a small space, helps us design refrigeration machines which require a minimum of space and weight for the required cooling capacity," say the Carrier men.

In the Gateway Center installations, more than 200,000 feet of integrally finned Trufin Type S/T, was used in the coolers and condensers of three 17M64 Carrier Centrifugal Refrigeration Machines of 1500-ton capacity each, and one 3000-ton capacity 17PM470 Carrier unit.

If your company is involved in refrigeration, air conditioning or other heat transfer applications, Wolverine Trufin Type S/T can help you do a better job—just as it does Carrier Corporation.

For complete information write for your copy of the Trufin Catalog.

CALUMET & HECLA, INC.
CALUMET DIVISION
URANIUM DIVISION
GOODMAN LUMBER DIVISION
WOLVERINE TUBE DIVISION

In Canada:
CALUMET & HECLA OF CANADA LIMITED
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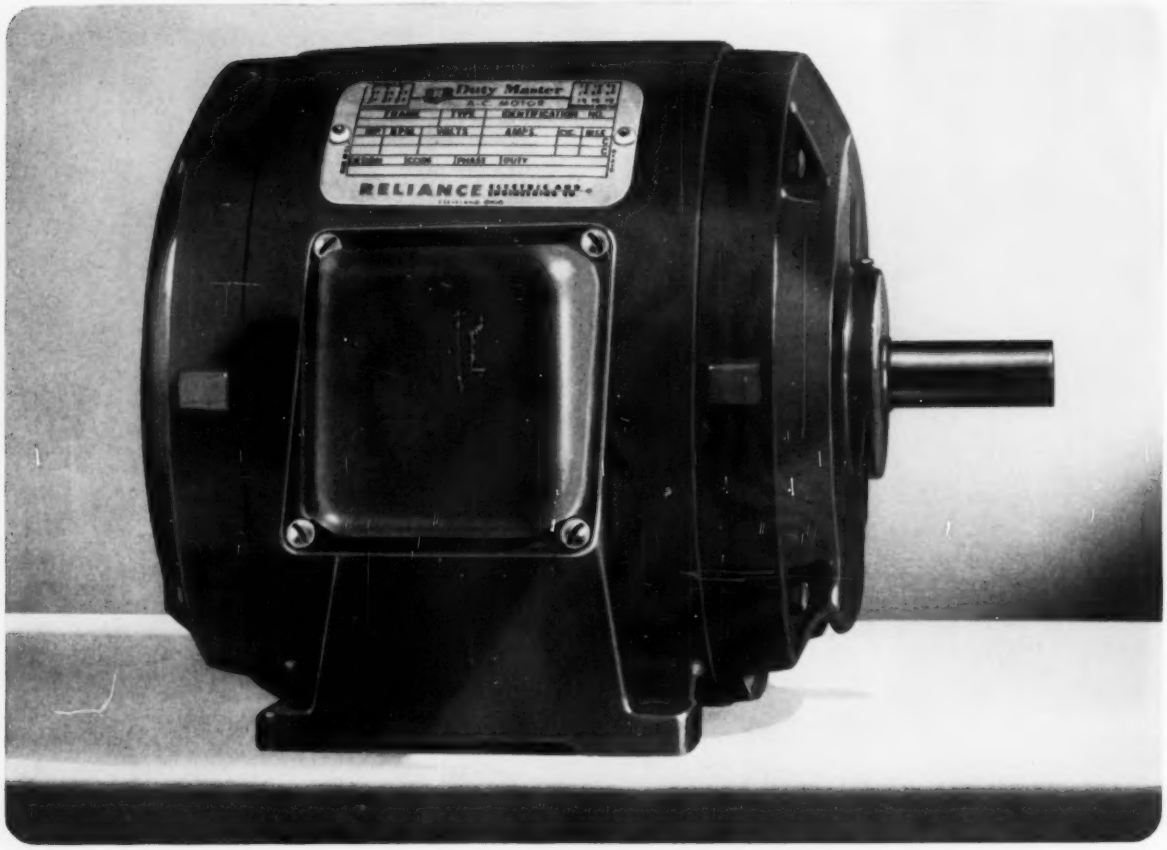
WOLVERINE TUBE
DIVISION OF
CALUMET & HECLA, INC.
17256 Southfield Road
Allen Park, Michigan

Manufacturers of Quality Condenser Tubing and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA. ☆ SALES OFFICES IN PRINCIPAL CITIES



Duty Master

a brand new a-c. motor

Product of Reliance Electric and Engineering Company and its Master Electric Division, Duty Master's new design gives users better protection from the inside out, simplified lubrication, better response and improved all around performance. The Duty Master line, from protected-open, to totally-enclosed, explosion-proof, 1 to 250 hp., is ready for delivery *NOW*.

Duty Master's insulation, by means of a series of multiple dips and bakes in thermosetting varnish plus final protection in finishing enamel, makes it resistant to water, acid, dirt and other contaminating elements . . . adds years to motor life.

"Metermatic" lubrication regulates flow of grease to the bearing—provides automatic grease relief. No danger of over-or under-lubrication . . . no maintenance headaches.

Duty Master's low inertia rotor has faster response in starting, stopping and reversing. This plus better ventilation and increased accelerating torques, permits frequent starts and stops without over-heating.

Duty Master's new design proves conclusively that all a-c. motors are *not* alike . . . that this new motor gives users the best value in industry today.

Call your Reliance Sales Engineer or distributor—write for Bulletin No. B-2106. B-3035-A

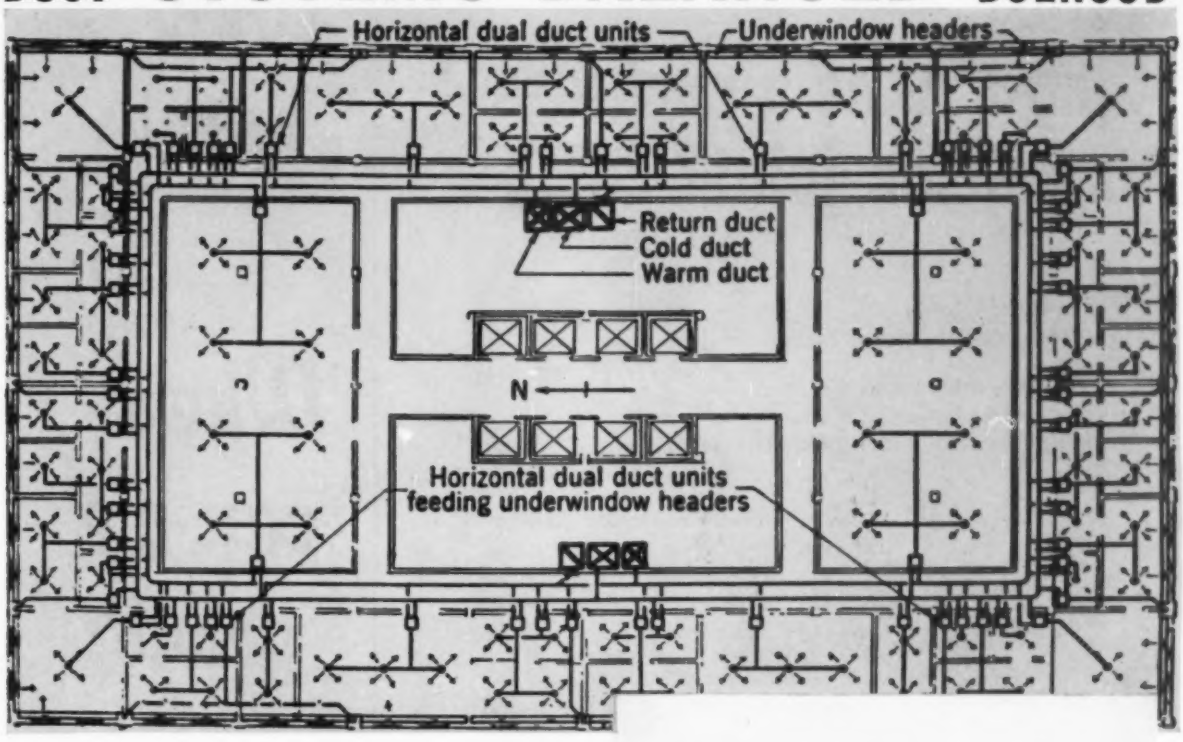
Product of the combined resources of Reliance Electric and Engineering Company and its Master and Reeves Divisions

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 3612A, CLEVELAND 17, OHIO
Canadian Division: Toronto, Ontario
Sales Offices and Distributors in Principal Cities

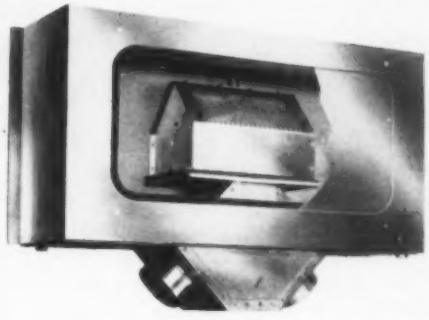
Duty Master A-c. Motors, Master Gearmotors, Reeves Drives, V★S Drives, Super 'T' D-c. Motors, Generators, Controls and Engineered Drive Systems.

DUAL DUCT SYSTEMS BALANCED BY BUENSOD



Shown above is a typical office building Dual Duct layout. It shows a floor plan for known-occupancy requirements in either a new or modernized old building. This economical, 100% all-air system is zoned to provide selective temperature control for each enclosure. Lack of under-window space is overcome by installation of overhead mixing units feeding air to slim distributing headers under the sill of the windows. This takes care of the skin effect of the building.

Illustrated: Buensod Type H unit designed for overhead installation, generally above hung ceilings. The unit may be connected to any standard ceiling diffuser or grille. Cutaway shows self-contained volume regulator in place.



Buensod Dual Duct air mixing units are the flexible, economical answer to your floor-by-floor air distribution problems. The series of Buensod diagram advertisements (of which this one is the third) illustrates this fact. The first advertisement showed a normal, all-air system for a commercial office building. Anticipated changes in space arrangement required much flexibility. The second advertisement presented a structure with the air system supplemented by radiation. In all three layouts the space arrangement and conditioning requirements are identical.

And in this third advertisement, the plan above shows a 100% all-air Dual Duct system for the floor plan where less flexibility—fewer changes in zones—are expected.

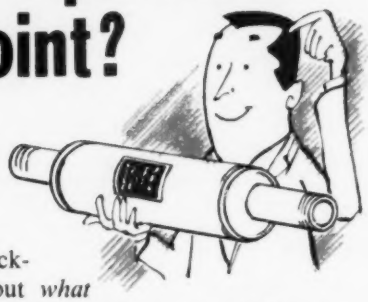
Dual Duct versatility is further enhanced by Buensod's *exclusive* pre-balancing of units at the factory. When so ordered, they will immediately deliver the specified air volume upon installation.

BUENSOD dual-duct

BUENSOD-STACEY

Buensod-Stacey, Inc., 45 West 18 Street, New York 11, New York

What ~~Who~~ makes a packless expansion joint?



Take a good look at that headline change.

Many firms make a packless expansion joint . . . but *what* makes it is equally important. The answer is: *the bellows.* Not just *any* bellows, but the *right* bellows for the job.

Every packless expansion joint we turn out is built around a bellows especially designed to give longer service under maximum conditions of the stress and strain to which it will be subjected.

Being inventors of the original Sylphon® Bellows, we think we know more about metal bellows than anyone else. Thousands of customers over the years have agreed with us . . . and still do.

When you specify a Robertshaw joint, you're not getting an assembly job of stock components: you're buying a precision product designed from start to finish by experienced bellows engineers. You're buying *performance*: you're buying the result of over 50 years of bellows manufacturing leadership.

Wherever you need such a lifetime, leak-proof, trouble-free joint in vertical or horizontal steam or water lines, in sizes from ¾" to 6", just remember *what* makes a packless expansion joint—and let us show you several good reasons why we're the *who*. Or get the whole story in Bulletin 65. **Fulton Sylphon Division, Robertshaw-Fulton Controls Co., Knoxville 1, Tennessee.**

Robertshaw ® MR CONTROLS

"Who makes it?"

"Where can we get it?"

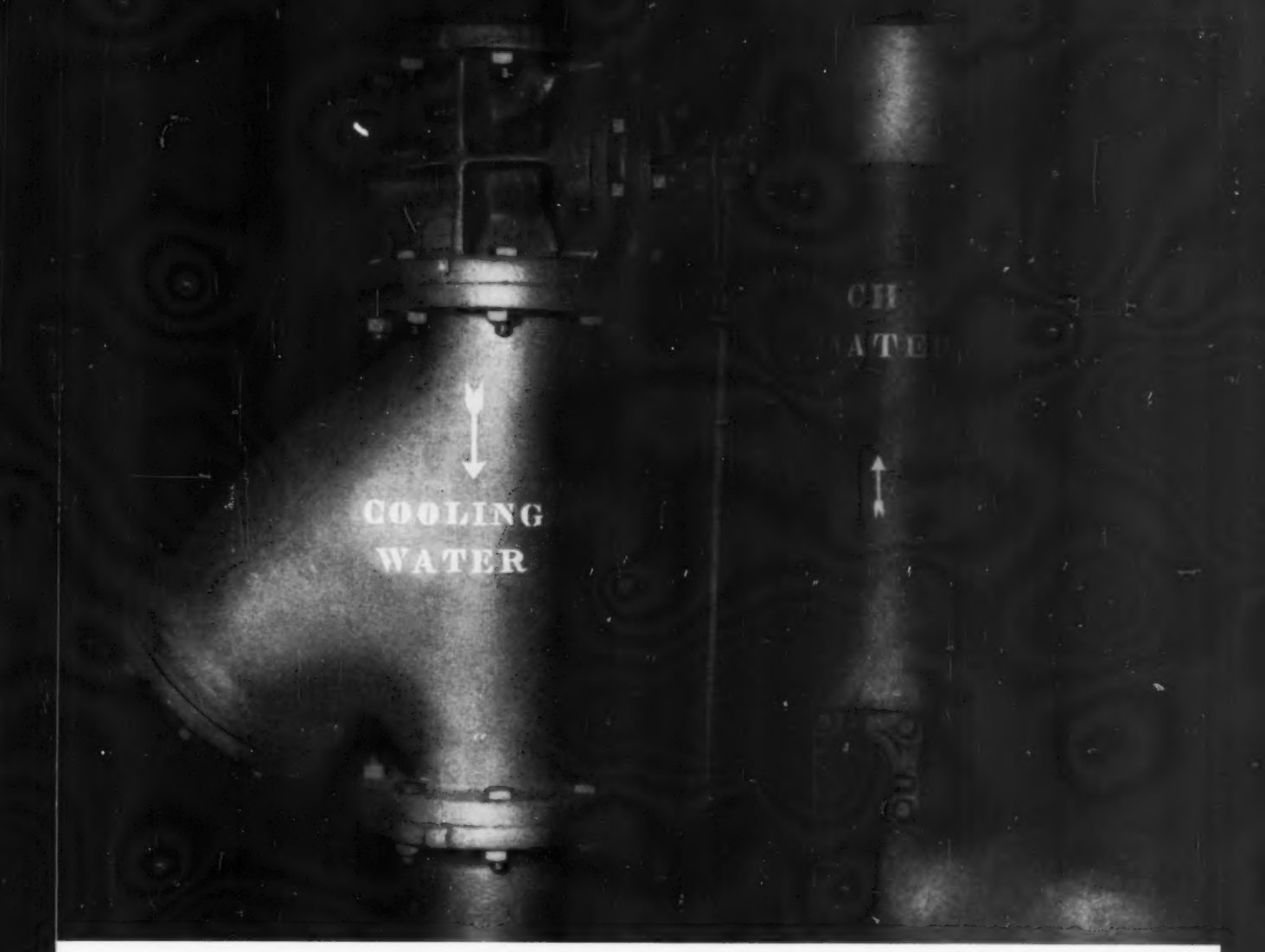
FOR THEIR ANSWERS

Consulting Engineers
Engineers In
Industrial Plants
Engineers In
Large Buildings
And
Mechanical Contractors

. . go to the
big annual

Heating, Piping & Air Conditioning JANUARY Directory Number

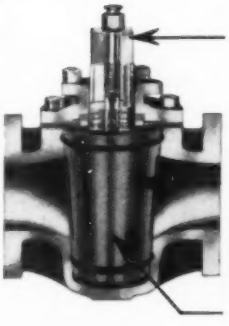
CLOSING DATE IS DECEMBER 10TH. BETTER PHONE NOW FOR SPACE STATE 2-6916



Get pin-point throttling accuracy on chilled water lines . . .

SIZES TO 36": Lines above 8" are no longer a problem. Specify sizes and pressure rating to meet your design needs.

COMPACT: No bonnet cavity or rising stem saves weight and space.



PERFECT BALANCE: Plug is smoothly, easily positioned for precise throttling . . . wrench shows degree of throttle.

THROTTLE or SHUT-OFF: If desired, shut-off valve can be eliminated downstream from throttle valve. Positive shut-off assured by pressurized lubricant.

NO CHANCE OF CHATTER: Solid tapered plug is perfectly seated in rugged body . . . no exposed seats . . . silent for the life of the building.

ROCKWELL-Nordstrom VALVES
another fine product by
ROCKWELL

More and more air-conditioning design engineers are assuring operating efficiency by insisting on Rockwell-Nordstrom valves to balance chilled water lines. A few of their reasons are illustrated in the cut-away valve pictured at the left . . . reasons that have been proved sound, practical and economical in air-conditioning installations everywhere. You can get complete details on Rockwell-Nordstrom valves for a wide variety of heating and air-conditioning applications by sending the coupon below. Better yet, why not have a Rockwell Field Engineer call on you? Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee, Peacock Brothers Limited.

SEND COUPON FOR COMPLETE DETAILS, TODAY

Rockwell Manufacturing Company
Pittsburgh 8, Pa.

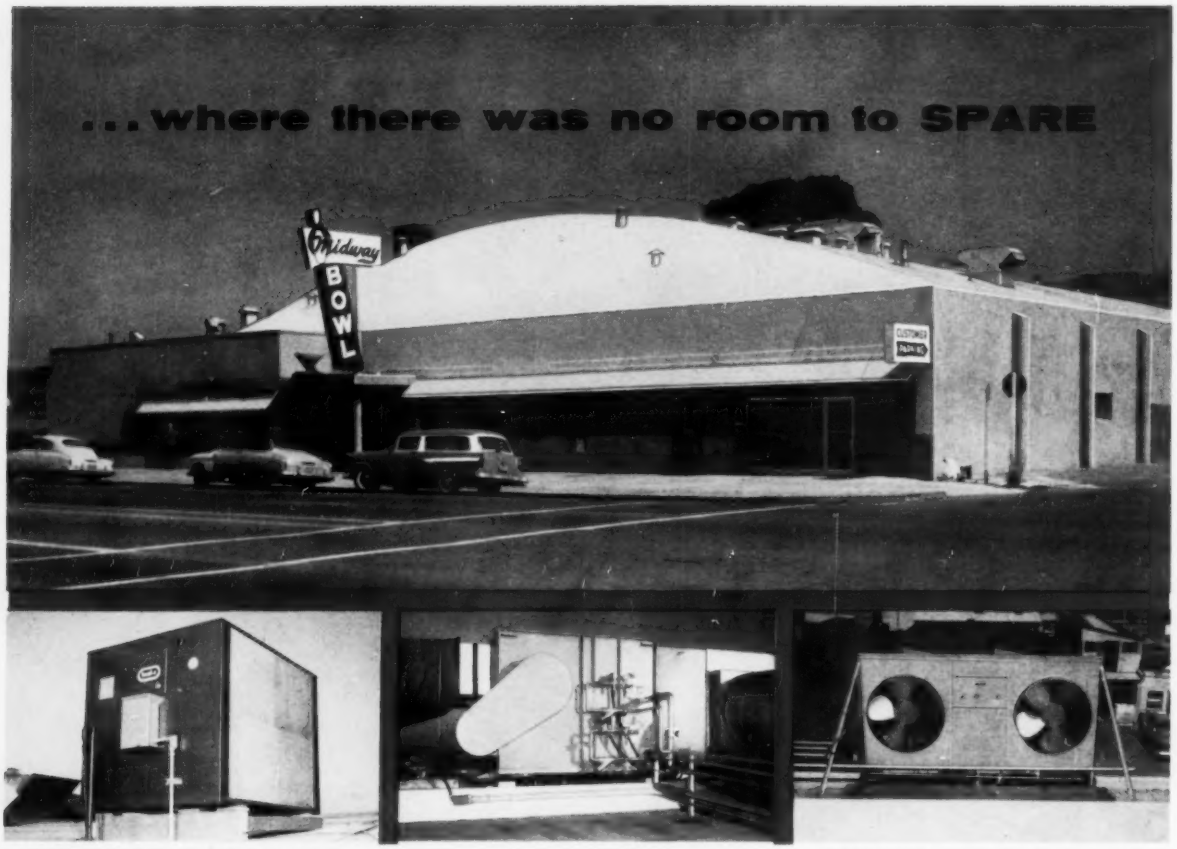
☐ Please send Bulletin V-203.

☐ Please have your representative call.

Name_____ Title_____

Company_____

City_____ Zone____ State_____



Heat-X 'RCU' Remote Condensing unit (used with 'CC' unit) for coffee shop and offices.

'HAH' Horizontal Air Handling unit (used with 'LRCU') mounted on roof, air conditions bowling area.

'LRCU' Large Remote Condensing Unit (used with 'HAH') serves bowling area.

DUNHAM-BUSH made a comfort STRIKE

'CC' Comfort Conditioner in office area (used with 'RCU').

ROOM AT THE TOP AND COMPACT DUNHAM-BUSH EQUIPMENT ENABLED MIDWAY BOWL TO INCLUDE CUSTOMER COMFORT IN REMODELING PLANS...

In the remodeling plans for Midway Bowl, San Leandro, California, addition of air conditioning for customer comfort was extremely important.

But space limitation in this 160′ x 125′ structure was a serious problem.

The solution was an applied combination of careful engineering and compact Dunham-Bush products. Result . . . the virtually all-roof-top installation of a highly efficient system.

Widely known for its broad heating and cooling service to large industrial and commercial buildings, Dunham-Bush also satisfactorily serves the smaller ones through 'one source—one responsibility' operation. The challenging circumstances under which Dunham-Bush products were specified and installed here at Midway may be right up your alley on your next job. Call the Dunham-Bush sales engineer near you for more information.

Dunham-Bush, Inc.

WEST HARTFORD 10 • CONNECTICUT • U. S. A.

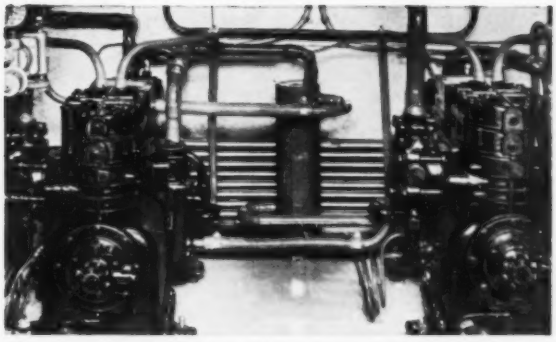
DUNHAM-BUSH

AIR CONDITIONING • REFRIGERATION • HEATING • HEAT TRANSFER

WEST HARTFORD, CONNECTICUT • MICHIGAN CITY, INDIANA
MARSHALLTOWN, IOWA • RIVERSIDE, CALIFORNIA

DIVISIONS

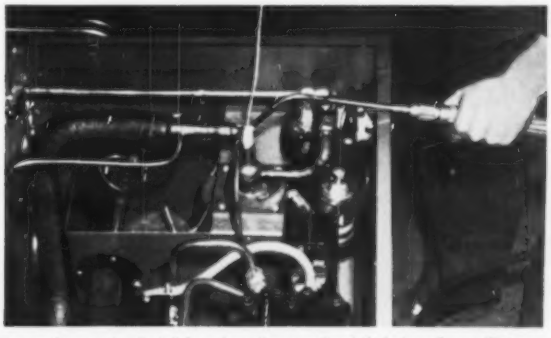
heat x



Here is a cascade refrigeration system using Freon 22 and Ethane refrigerant. This system cools five gallons of oil per minute to minus 70° F. All of the refrigerator tubing on both high- and low-pressure sides is brazed with SIL-FOS (approximately 185 joints). Some joints fluctuate in temperature from minus 200° F to plus 70 or 80° F.

Here, operator brazes the tube bundle before assembling it in condenser shell. Hand gas-air torch keeps the SIL-FOS flowing freely.

Now the tube bundle is being brazed to the sheet by the same simple heating method.



Operator puts finishing touches on last joints of small two-stage unit.

20 Years Without A Joint Failure . . . Harris Refrigeration Sets This Record With SIL-FOS

This 20 year failure-free record is even more remarkable since the joints of Harris equipment are subjected to extreme temperature, pressure and thermal shock far in excess of an ordinary refrigerator.

A pioneer in the design and manufacture of low-temperature refrigeration equipment for science and industry, Harris Refrigeration Company, Cambridge, Massachusetts, finds Handy & Harman SIL-FOS the brazing alloy that meets all its stringent requirements for high strength, leak-tightness and durability. Specified for 20 years in the production of Harris units ranging from small refrigerators for cold-treating ball bearings to a giant big enough to chill a 20-foot, 10-ton mill roll, SIL-FOS has always assured highest quality joints while providing the production flexibility and economy essential to efficient manufacturing.

Time, strength and leak-tightness are, by themselves, excellent reasons for specifying SIL-FOS. There are many more. Like brazing's inherent economy. Like the ease and speed with which joints are made. And like the quality SIL-FOS joints assure your product. We would like to give you all the necessary brazing background you may require . . . call us.

GET THE FACTS FROM BULLETIN 20

This booklet gives a good picture of silver brazing and its benefits . . . includes details on alloys, heating methods, joint design and production techniques. Write for your copy.

Your NO. 1 Source of Supply and Authority on Brazing Alloys

HANDY & HARMAN

General Offices: 82 Fulton St., New York 38, N. Y.

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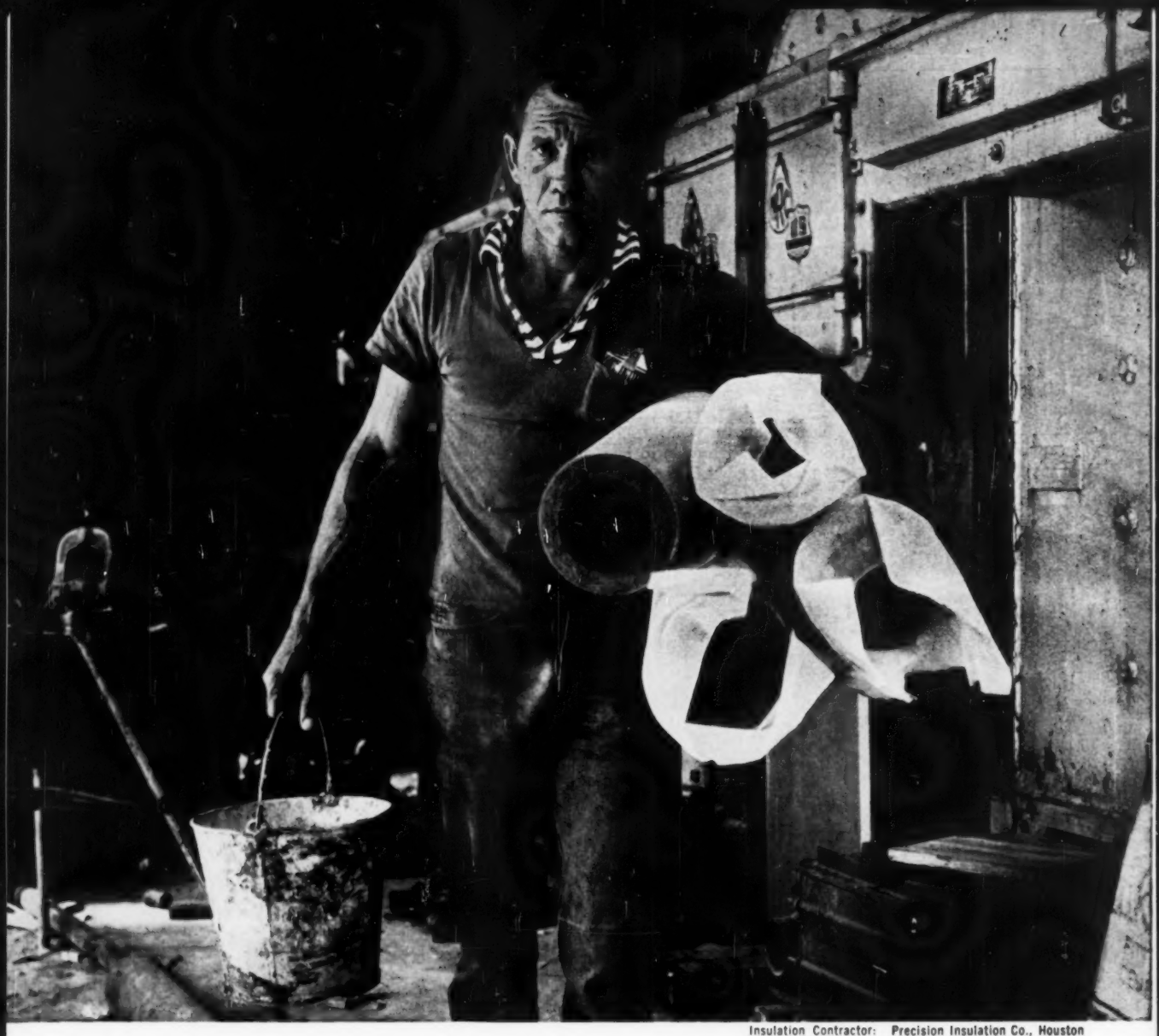

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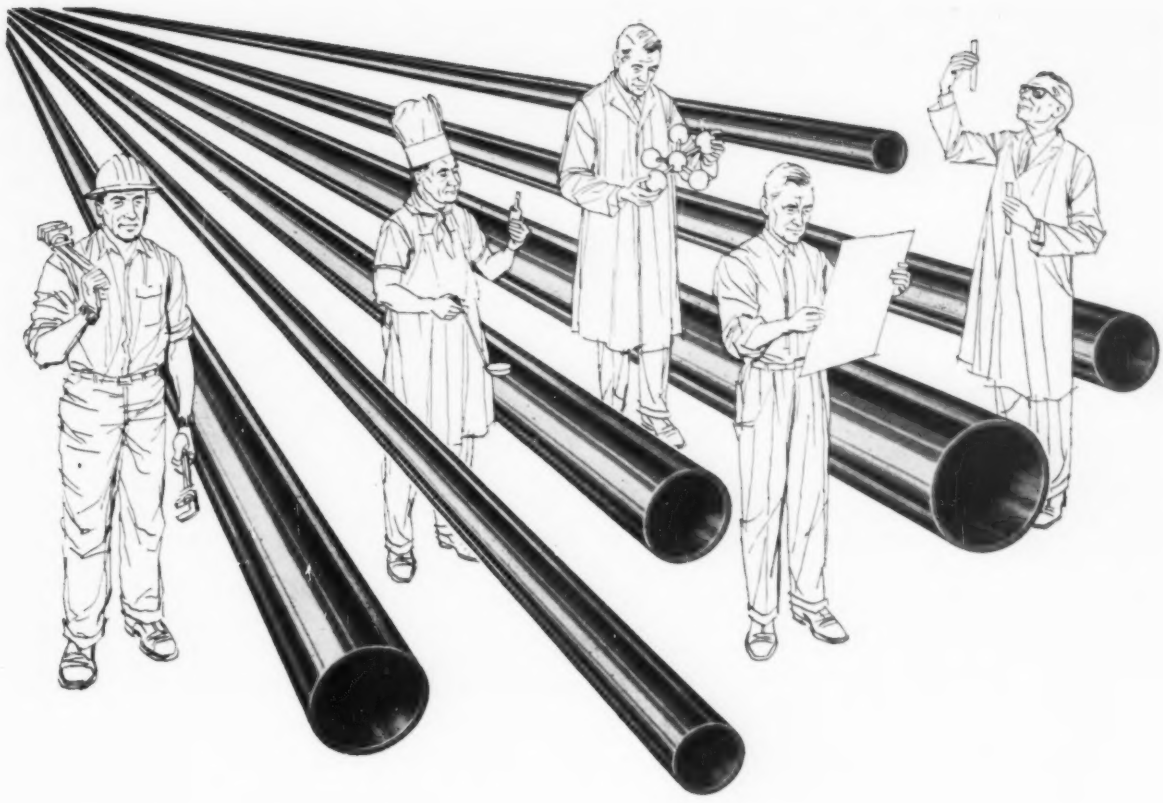

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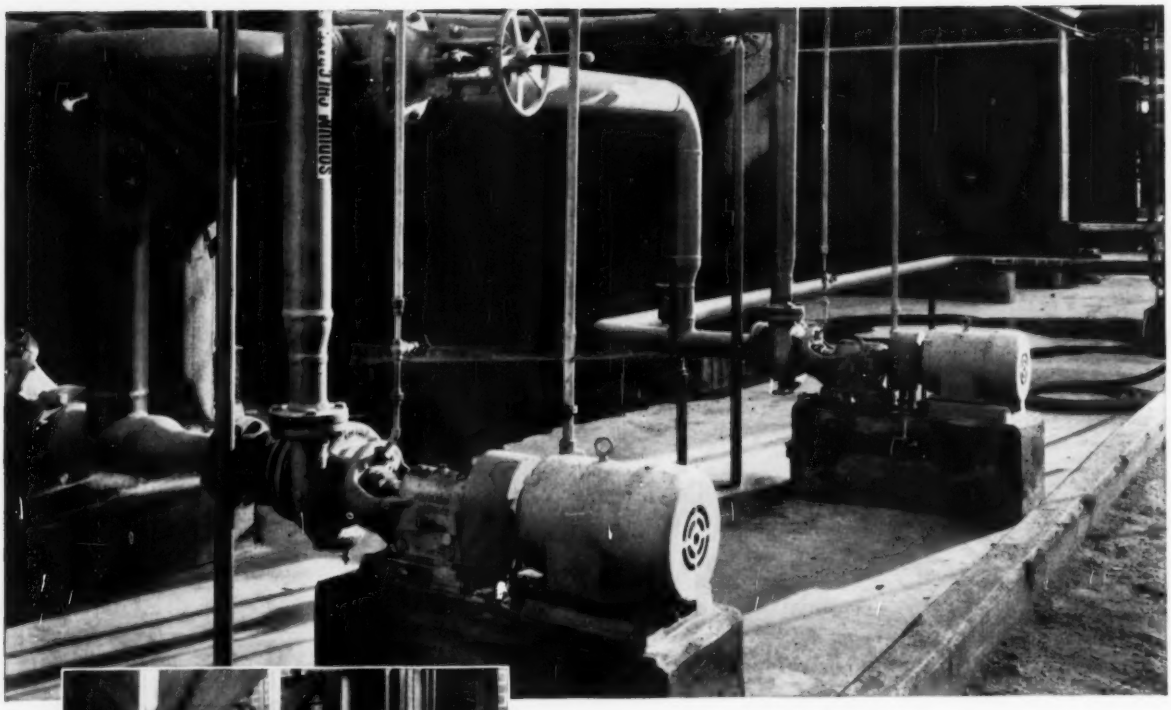

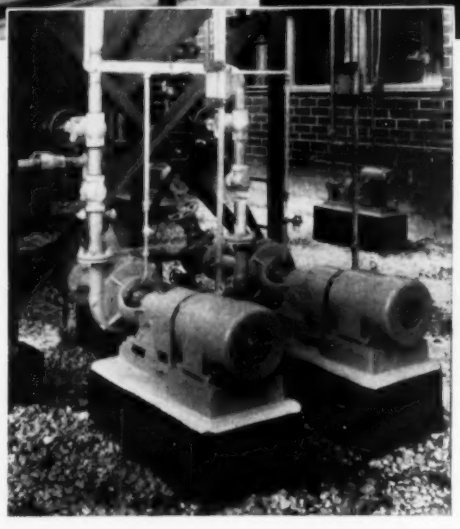

Above — "Buffalo" Single Suction Full Ball Bearing Pumps, stainless steel construction, handling sodium chlorate.

CORROSION— CONTAMINATION CONTROLLED WITH "BUFFALO" PUMPS

At left — "Buffalo" Single Suction Pumps of stainless steel construction handling hydrogen peroxide bleach.

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"open for discussion"

• WE FOLLOW HERE each month the practice at engineering society meetings of providing an "open for discussion" period. You are urged to take part. Just address your comments to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

U. of C. Heating Plant Reflects Sound Design, Choice of Materials

LYMAN R. FLOOK'S article, *U. of C. Central Plant Marks 30 Years of Reliable, Low Maintenance Heating* (November), is indeed a testimonial for sound engineering. The soundness of both the design and the selection of materials incorporated in the installation is noteworthy, as is evidenced by the relatively few changes and replacements required during the 30 years the plant has been operating.

The small percentage of makeup shows that the transmission and heating systems are well sealed even though some of the buildings are more than a half-century old. The variation in factor "X," as charted in Fig. 6, is remarkably constant, the changes indicated probably being caused by periods during new construction activity on the campus. The total of 930,016 tons of coal burned to deliver 11,847 million lb of steam reduces to about 6-1/3 lb of steam per pound of 12,000 Btu coal for the 30-year period. The low average annual load duration factor probably accounts for this being rather on the low side.

I am familiar with the physical plant at the University of Chicago and am not surprised at the favorable report of the facilities described. Mr. Flook has been instrumental in sponsoring policies during the life of the plant that have resulted in its present satisfactory condition. He is to be congratulated for the result and commended for his interesting article.

LESTER S. RIES
Consulting Engineer

Make Sure Inert-Gas Tungsten Arc Welding Equipment Is in Top Shape

AS HELMUT THIELSCH points out in his article, *New Consumable Insert Ring Extends Use of Inert-Gas Tungsten-Arc Pipe Welding* (November), the use of the silicon deoxidized consumable insert ring has, to a large degree, helped to solve a troublesome problem in the inert-gas tungsten-arc welding of carbon steel. The same problem has occurred but to a lesser degree in chromium-molybdenum alloy steel piping—probably because such materials have been better deoxidized than the lower grades of carbon steel.

Experience has shown that, in the use of the inert-gas tungsten-arc method of welding, it is extremely important to have the welding equipment in top condition at all times. In particular, care must always be exercised to insure that the hoses and connections are dry and clean and that the gages are accurate and in good condition. The hoses and gages should be protected and handled carefully. Although such care of equipment may seem elementary, it should be observed rigorously to help in overcoming the troubles that sometimes occur when using the inert-gas tungsten-arc method.

I. A. ROHRIC
Materials Engineer
General Engineering Dept.
Generating Div.
The Detroit Edison Co.

Use of Orifices Has Nothing to Do With Finned Tube Heat Distribution

IN HIS ARTICLE, *What Central Control for Steam Heating Can and Cannot Do* (July), Lewis Smith presents a clear and enlightening case for the use of central control for steam heating.

Unwittingly perhaps, many owners (and engineers as well) have confused incorrect zoning or poor heat distribution on some "trouble" jobs with the idea that there is something basically wrong with central control. The many fine installations now in existence belie this, of course.

One point in Mr. Smith's discussion regarding finned tube radiation might confuse the uninitiated. He says: "With either intermittent (on-off) control or one

"open for discussion"

continued

using metering orifices, partial heating must take place at all times except when full heat is required. . . . By expanding the steam under a vacuum, with the resulting drop in steam temperature, a single tier [finned tubing] can be used because it will stay full of steam the whole length until very mild weather is reached when partial filling will no longer cause complaint."

The inference created by the lumping of "on-off" systems and "one using metering orifices" is that only subatmospheric systems using vacuums up to 24 in. Hg would be suitable for this application.

However, the fact is that the use of orifices has nothing to do with the problem, since even the so-called "high vacuum" systems use orifices to properly distribute heat.

Any system employing steam at a vacuum and using the principle of true differential pressure control will achieve the same result. It is important that consulting engineers who specify central control — and owners who use it — be perfectly clear that there are three basic central control systems available today:

1) "On-off" control providing intermittent shots of steam at full pressure timed to suit the prevailing outdoor temperature.

2) Reduced pressure control where the motorized valve acts as a pressure reducing valve giving full steam pressure and 100 percent steam flow at the coldest outside temperature and reducing the pressure and steam flow as the weather gets milder.

3) "Differential" control which carefully regulates the pressure difference between the supply and return mains in accordance with changes in outdoor temperature. Since the condition of steam in the return main is a function of the heat output of the system, this type of regulation will take into consideration all the factors which are necessary for proper control.

T. Robert Stevens
Vice President
Sarcotherm Controls, Inc.

The author's reply — I think we may be talking at cross-purposes about orifices. There are two kinds:

1) A metering orifice having a small opening and a high pressure drop of maybe 3 psi maximum. By adjusting the pressure differential across it, the flow of steam into a radiator is varied. Since reliance is placed mainly on partial filling of the radiator, the difficulty when using a long finned pipe convector should be obvious.

2) A regulating plate having a large opening and a maximum pressure drop measured in ounces. This kind of orifice is used with true subatmospheric systems capable of operating up to a high vacuum and relying mainly on the degrees of vacuum (and consequently steam temperature) for control. The primary function of such a plate is to produce a uniform partial filling of all of the radiation in very mild weather. Complete filling of long finned pipe convectors can be maintained in all except mild weather.

Hence, I think the statements in my article are correct and that the use of orifice plates has a great deal to do with the problem. The confusion lies in the type of orifice we are talking about.

I cannot go along with Mr. Stevens' classification of the three basic central control systems available today. I think his No. 2 and No. 3 are one and the same. I would call this No. 2. My No. 3 would be the subatmospheric system.

It might be a good idea for the industry to get together and adopt a uniform nomenclature.

Lewis Smith
Heating Engineer

Consider Variable Heat Transmission In Aircraft Air Conditioning Design

The article, *Design Jet Bomber Environment for Wide Temperature, Pressure Extremes* (September), by Amos B. Hartley, well covers the problems involved in air conditioning high altitude aircraft. The complexities of the control of inside conditions under the extremely variable external conditions of temperature, altitude, pressure, and other factors are very well presented.

Based on available information generally accepted as being correct for 40 deg north latitude, the following table indicates the variable ambient conditions encountered:

Altitude, ft	Ambient temperature, F	Barometric pressure, in. Hg	Specific wt, lb per cu ft (approx.)
sea level	+100	29.92	0.0765
5000	+ 82	24.89	0.0659
10000	+ 64	20.58	0.0565
20000	+ 28	13.75	0.04075
30000	− 7.6	8.88	0.0286
40000	− 44	5.54	0.0187
50000	− 67	3.44	0.0116

In addition to the above variables encountered by the plane's air conditioning system, consideration must also be given to the matter of heat transmission which varies with altitudes and aircraft speeds. A plane flying at 350 mph at 20,000 ft will develop a skin surface temperature of + 50 F due to air resistance usually referred to as the temperature created by "ram compression." Flying at 20,000 ft at a speed of 750 mph, the skin surface temperature of the aircraft can be expected to reach + 125 F.

To reach greater speeds, a flying plane must resort to higher altitudes and lower ambient air temperatures. For example, to attain a flying speed of 750 mph at 40,000 ft, the skin surface temperature could be expected to reach + 50 F.

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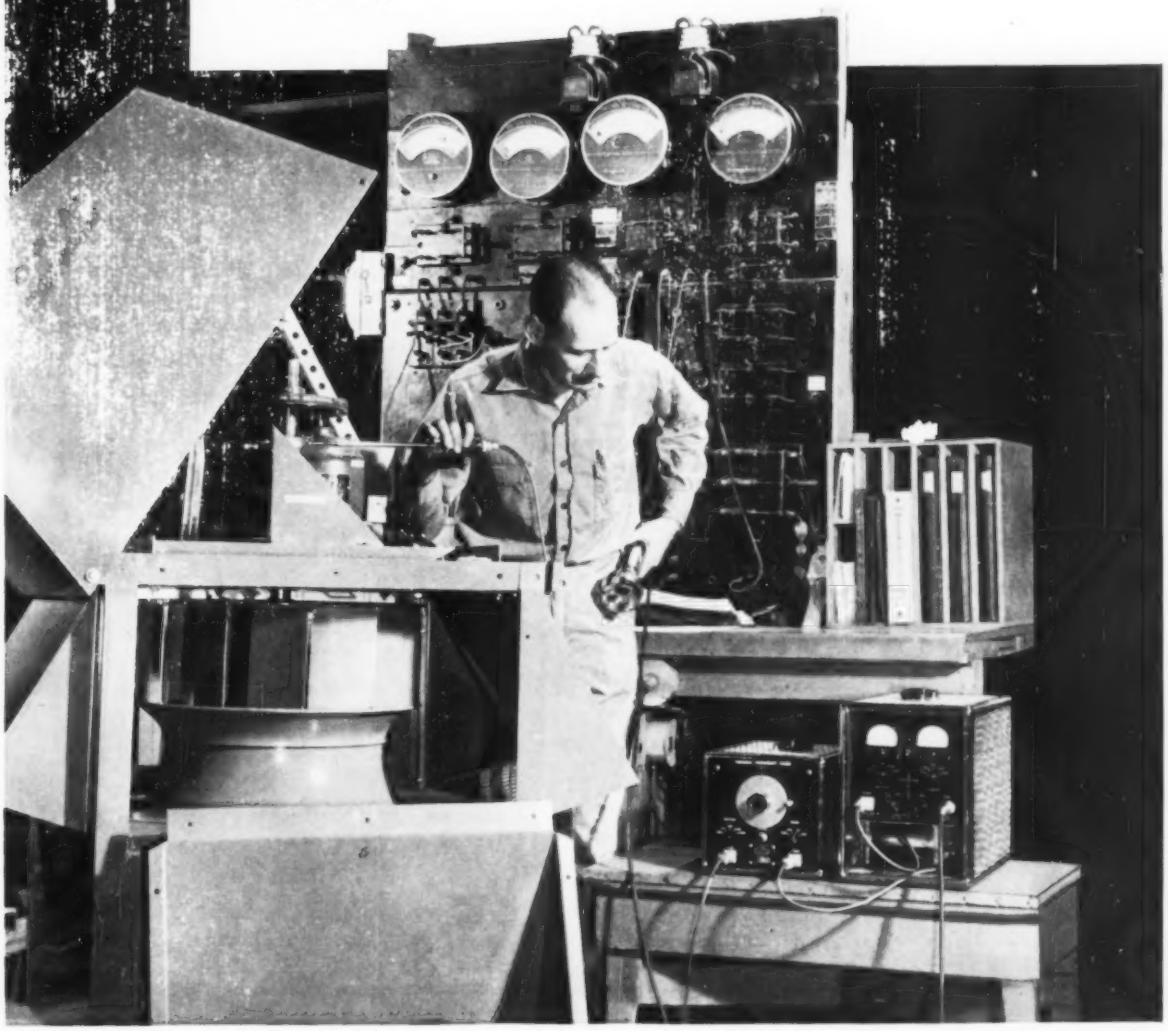


question of the month

"How Can I Figure Supports For a Horizontal Tank?"

This question was asked previously in Heating, Piping & Air Conditioning and is repeated here, along with an answer that has been received from a reader. Earlier answers appeared in the October issue. Other solutions or comments for publication are invited.

"How should I design the supports for a horizontal tank, 10 ft, 10 in. in diameter × 50 ft long?

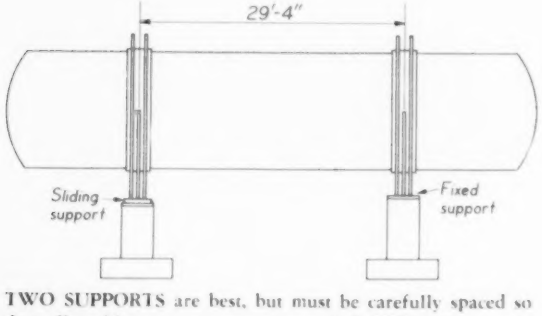
"The vessel has been fabricated from ¼ in. thick steel plate and has dished heads. The tank is to be used for ammonia absorption and will be filled with water. The operating pressure will be 25 psi. The tank will be supported by concrete saddles.

"How far apart should I place the saddles? How many saddles should I use, without placing undue stresses on the shell?" — R.W.G.

Locate 2 Supports at Points Where Bending Stresses Will Be Minimum

EXPERIENCE in the design of equipment for the process industries indicates that all such equipment should be designed to withstand the *worst possible* conditions that may be anticipated.

It has been common practice in the past to support thin wall tanks on a series of saddles, either concrete or masonry, their number usually being selected by some rule of thumb. In the present case, where the tank is 10 ft, 10 in. in diameter × 50 ft long, there would probably be nine saddles on 6 ft centers.



TWO SUPPORTS are best, but must be carefully spaced so that allowable stresses are not exceeded. Sliding support at one end compensates for expansion

Since it would take at least 4 cu yd of concrete per saddle, the cost of building forms and other items makes this a rather expensive procedure. Consideration should therefore be given to the use of fewer supports, preferably just two, since this number has been found to provide the most desirable condition.

Once it has been decided to use two supports, it is necessary to investigate the bending and other stresses imposed upon the tank, as well as the allowable stresses for a structure of this kind. The governing stress is the critical buckling stress of a shell subjected to a compressive stress. A very conservative value of this is:

$$f = 0.15\ E\ (t/R)$$

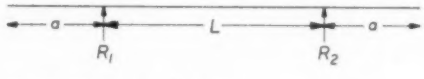
where:

f = unit stress, psi
E = modulus of elasticity
t = thickness, in.
R = radius, in.

In the present case, this becomes:

$f = 17{,}000$ psi

Supports should be located at such points that bending stresses will be minimum. In a uniformly loaded beam with both ends overhanging and supports symmetrically located, the following formulas apply.



f_s (at supports) $= w \times a^2/2S$

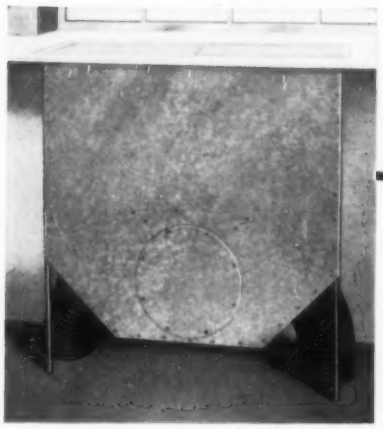
f_s (at center) $= w\,(L^2 - 4a^2)/8S$

where:

w = load per unit of length
L = distance between supports, in.
a = distance from supports to ends, in.
$S = I/c$ = section modulus.

The minimum stress occurs when f_s equals f_c. By equating the above formulas, this occurs when $L =$

at the new National Bank of Detroit main office . . .



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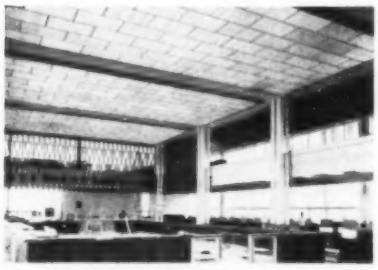

On the main banking floor a grid of aluminum, gold anodized, hexagonal cell lighting diffusers hangs approximately 20" below the ceiling proper, hiding ceiling-mounted lighting channels. Ducts running through a piping space above the ceiling introduce air through Kno-Draft adjustable ceiling air diffusers, all of which enable easy adjustment of air pattern.

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2.83a. Since the beam is 50 ft long, $L + 2a = 50$ ft and $a = 10$ ft, 4 in. (the distance that the supports are to be placed from the ends of the tank).

The section modulus (I/c) of a ring (section through tank) is:

$$S = \pi D^2 \times (t/4)$$

and

$$S = 3300 \text{ cu in.}$$

The total weight of the tank filled with water is 305,000 lb, which is 6100 lb per ft or 508 lb per in. of length.

Solving for the stress at the supports

$$f = (w \times a^2)/2S$$
$$f = (508 \times 124^2)/(2 \times 3300)$$
$$f = 1180 \text{ psi}$$

The stress at the center will be the same and is well within the allowable limits.

The tank will then be supported on two saddles. In this case, we will make them 20 in. (along the longitudinal axis of the tank) and 130 in. wide (diameter of the tank). The reaction at each support is 305,000/2, or 152,500 lb. The saddle will have a projected area of $20 \times 130 = 2600$ sq in. Then the unit pressure on the saddle will be 152,500/2600 = 58.5 psi. This pressure acting against the lower half of the tank will cause an inward bulge and some means of strengthening the tank at this point must be devised.

A practical method of calculating the reinforcement required at the supports would be to consider that area of the tank as a pressure vessel subjected to external pressure. In this case the external pressure will be 58.5 psi, and the center-to-center distance between two adjacent stiffening rings will be 20 in.

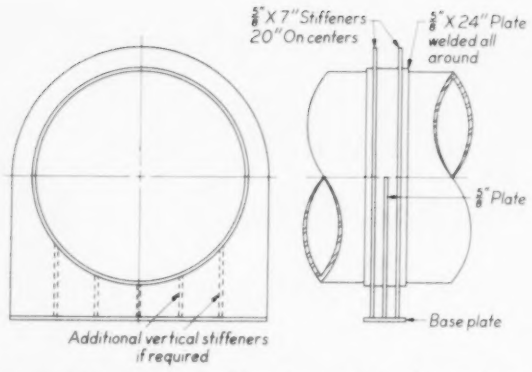
Referring to the ASME Code for Unfired Pressure Vessels, 1926 Ed., Paragraphs UG-28 and UG-29, we find that a 5/8 in. shell with 5/8 in. × 7 in. stiffening rings on 20 in. centers is adequate for this pressure. A 5/8 in. × 24 in. plate is then fitted to the tank and welded all around, and the 5/8 in. × 7 in. rings welded to the plate on 20 in. centers. This reinforcement will be adequate if the tank is supported on a saddle and the reaction is distributed evenly over the whole area.

To support the tank without adding separate saddles, the reinforcing rings are extended down and welded to a base plate. The weight of the tank is thereby transmitted to the rings and it becomes necessary to investigate the plate between the rings to see if it will sustain the required loading.

Assume a strip of plate 1 in. wide and 5/8 in. deep between supports 20 in. on centers, with a uniform loading of 58.5 psi. The section modulus of the strip is 0.065 cu in., and

$$f = (w \times L^2)/8S$$
$$f = (58.5 \times 20^2)/(8 \times 0.065)$$
$$f = 45{,}000 \text{ psi}$$

Since this exceeds the allowable stress, another ring is added midway between the existing two. And, since the distance between supports has been cut in half, the stress will be one-fourth of the above, or 11,250 psi, which is within the allowable.



UNIT PRESSURE on saddles (58.5 psi, in this case) requires reinforcement to protect tank. Here, stiffeners 20 in. on centers afford this protection

The supports thus described when secured to concrete piers will be satisfactory, provided the tank is used for storage purposes only and is not subject to any changes in temperature.

Since absorption of ammonia vapor takes place in the tank, and there is a change of state from vapor to liquid, the latent heats of liquefaction and absorption are liberated. This results in an increase in temperature of the solution. Reference to published data on the temperature-pressure concentration relations of aqueous solutions of ammonia indicate a temperature of 240 F with a concentration of 5 percent and a pressure of 25 psi. Under these conditions, the change in length of the tank from 60 F will be 0.7 in.

If the tank is restrained from longitudinal movement, the change in stress due to expansion will be

$$f = E \times e \times td$$
$$f = 29 \times 10^6 \times 0.0000067 \times td$$

then

$$f = 200 \times td \text{ (approximately)}$$

where:

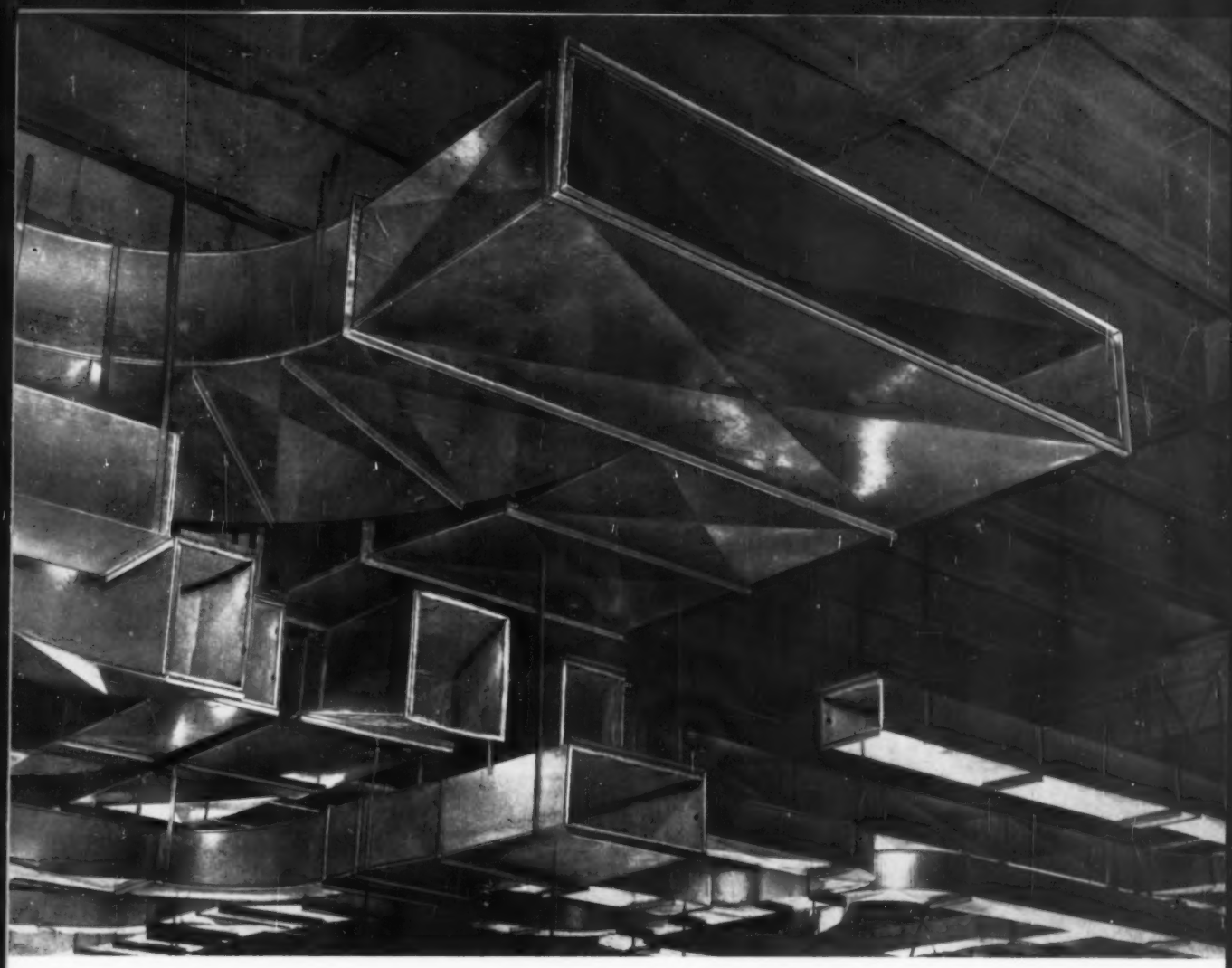
e = coefficient of linear expansion
E = modulus of elasticity
td = temperature difference, F.

For each degree rise in temperature, the stress will be increased 200 psi, and the allowable stress would be reached with an 80 F temperature rise. One end of the tank should therefore have a fixed support and the other end a sliding support to allow for longitudinal movement.

Some force is required to move the tank due to friction of the sliding support. The weight on the support is 152,500 lb. Common practice is to take the coefficient of friction for a sliding support as 0.5. Then force = 152,500 × 0.5 = 76,250 lb. The compressive stress on the shell will be 76,250/(D × π × t) = 743 psi, which amount is negligible.

To prevent any overturning due to wind pressure, the sliding support should be held down by suitable gibs.

JULIUS BRODSKY
Design Engineer



All ductwork was fabricated in Dallas by the Straus-Frank Company.

Ductwork made from USS Galvanized Steel installed in two Dallas Mercantile Buildings

It took 285 tons of galvanized steel sheets to make ductwork to air-condition the recently constructed Mercantile Dallas Building and the eight floors added to the Mercantile Continental Building in Dallas, Texas. An unusual inter-building heating and refrigerated-water air-conditioning system ties these structures to the older Mercantile Securities and Mercantile National Bank Buildings.

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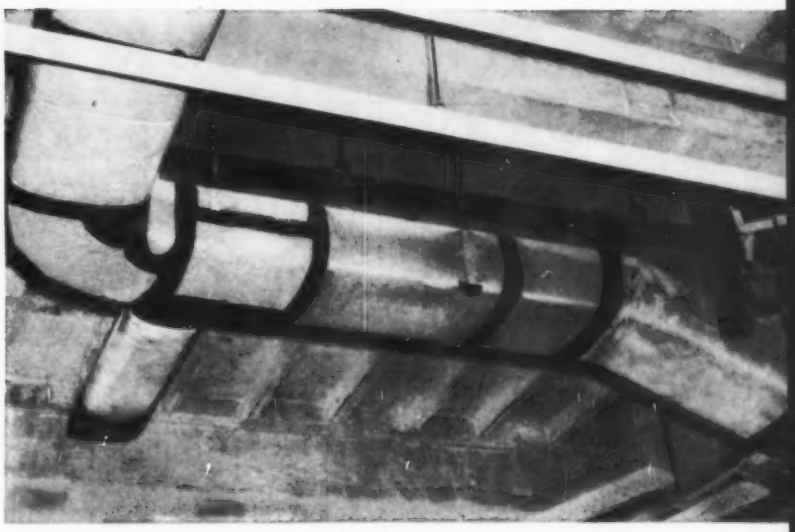


Pittsburgh Superfine Duct Insulation

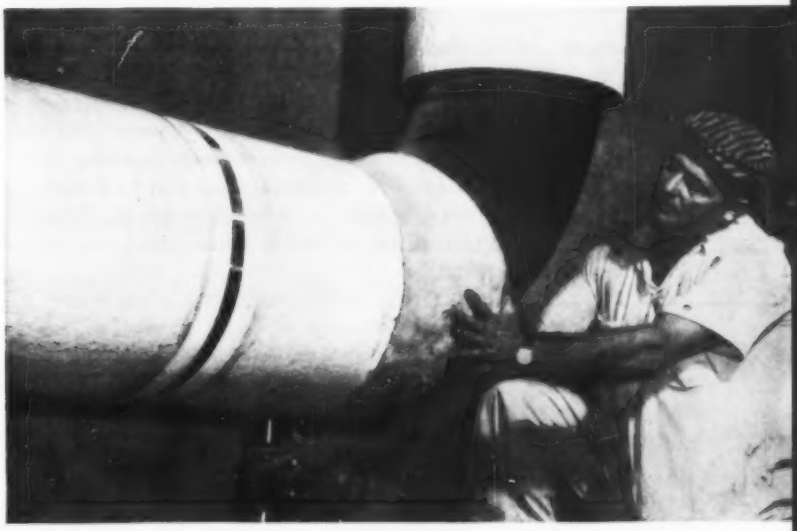
FOR THERMAL CONTROL

wrap-around fiber glass insulation, available in a variety of facings . . . shipped in blanket form . . . lightweight, easily handled . . . clean, non-irritating, odorless . . . good appearance . . . high thermal efficiency . . . flexible, resilient . . . readily fits any desired dimension . . . can be glued, tacked, taped or tied.

Pittsburgh Superfine Duct Liner

FOR THERMAL AND ACOUSTICAL CONTROL

coated with neoprene to prevent air erosion and reduce air resistance . . . low k factor . . . shipped in easy-to-handle lightweight rolls . . . easily cuts to correct size . . . can be glued, tacked or taped . . . can be applied to flat sheet before forming.



Pittsburgh Pipe Insulation

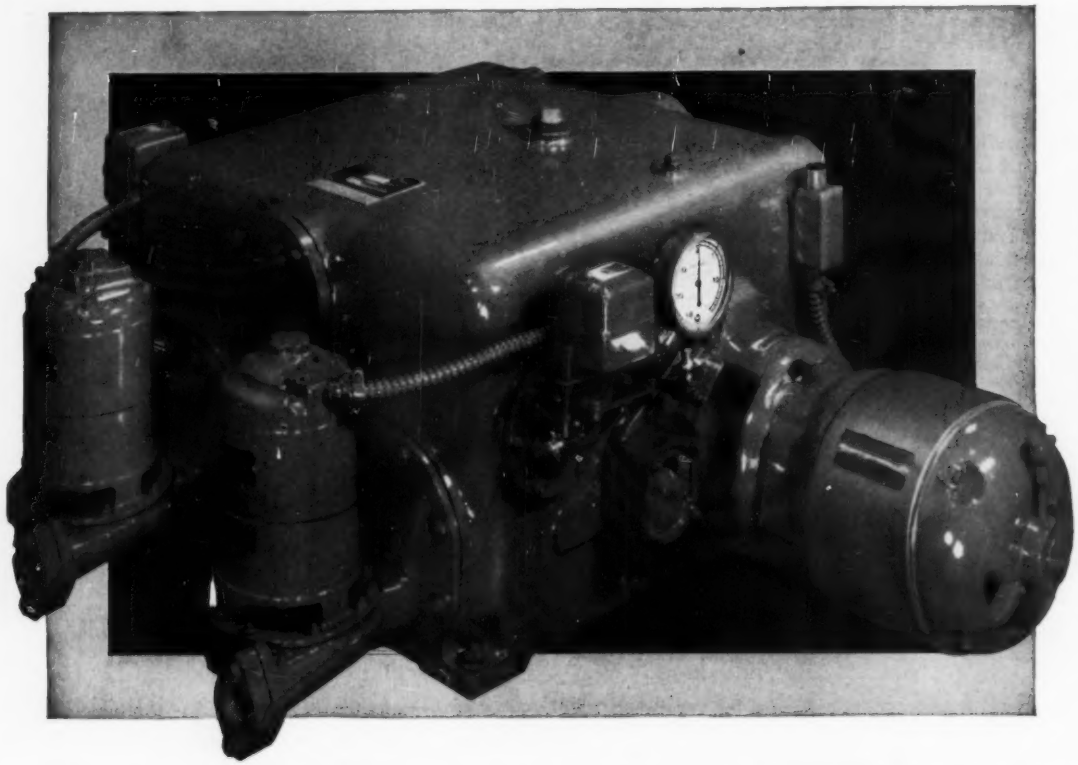
FOR THERMAL CONTROL

molded into a flexible hollow cylinder, slit along its length to provide quick application to pipes or tubing . . . provided in three-foot lengths, with or without jackets, in nominal wall thicknesses ½", ¾", 1" and 1¾" in all standard IPS and CWT sizes . . . has high thermal efficiency . . . low maintenance.

FIBER PG GLASS PITTSBURGH PLATE GLASS COMPANY

THIS NEW VACUUM HEATING PUMP

HAS THE INCREASED AIR CAPACITY EFFICIENT HEATING PRACTICE DEMANDS



It's the Nash CSM

Designed and manufactured by the organization that made the Jennings Manifold Heating Pump standard of the Heating Industry, the new CSM incorporates every desirable feature architects, engineers, owners and operators have sought. Employing separate air and water pump elements, each with its own motor and each independently controlled by its own automatic switch, the capacities and arrangement may be widely varied to meet job conditions. For the first time, the engineer has the choice of realistic water and air capacities required for rapid system response without wasteful overheating.

These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
- Control system that operates individual pumps only when needed.
- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

NASH ENGINEERING COMPANY
437 WILSON, SO. NORWALK, CONN.

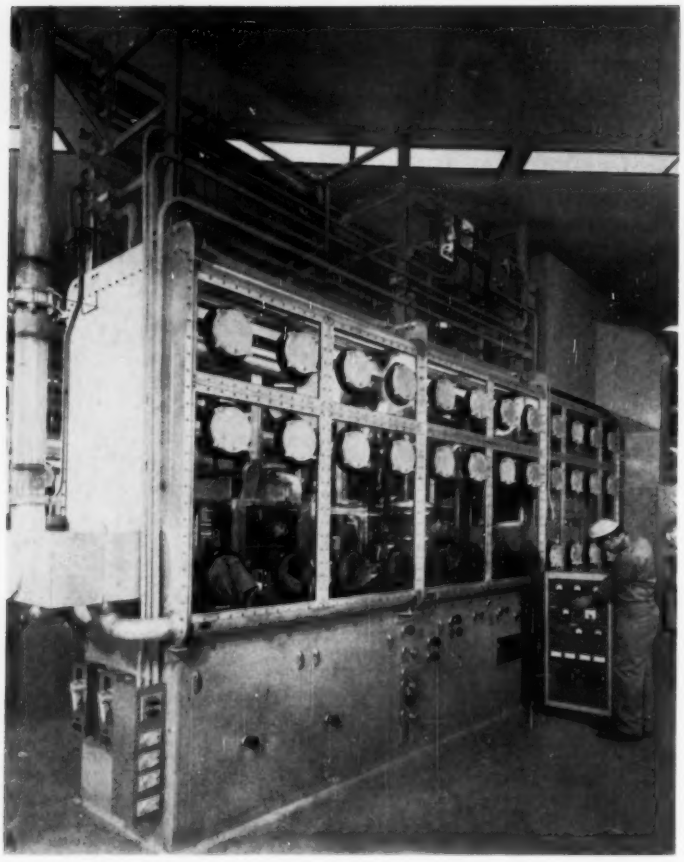
HELIUM IS DELIVERED to enclosed compartments where plutonium fuel elements are molded, machined, heat treated, ground, polished. Conveyor moves fuel elements from one station to the next and 106 glove openings permit operators to move fuel elements where necessary

Select Stainless Steel Piping, Ducts For New Plutonium Fabrication Facility

. . . enclosed helium hoods provide inert atmosphere

THE NEW Fuel Fabrication Facility at Argonne National Laboratory near Chicago was designed to make possible developmental research on techniques for fabricating plutonium fuel elements for nuclear reactors. Because plutonium is highly toxic, radioactive, and pyrophoric, the fabrication must be accomplished in an inert atmosphere. To protect operating personnel, an integrated system of hoods or glove boxes containing a helium atmosphere is gasketed together to prevent air leakage. There are 106 such hoods or glove boxes in the building.

The helium atmosphere consists of two separate stainless steel piping circuits. One is for recirculating either 1000 or 2000 cfm of helium, depending on the needs, and the other is for regenerating and purifying 100 cfm of helium constantly. A normal operating pressure of −0.6 to −0.8 in. water gage is maintained in the glove boxes with reference to the room. All piping and ducts are stainless steel with welded joints.



COOLING WATER is pumped to helium atmosphere enclosures at negative pressure through piping shown at top. Negative pressure prevents leakage which would increase possibility of nuclear accident. Two turbine pumps, two water jet eductors accomplish this

Nearly 10,000 cu ft of helium is kept constantly in motion through the enclosure system. Since helium is extremely scarce, care was taken in designing and building the process enclosures to keep the leakage of gas to an absolute minimum. The helium is pumped at less than atmospheric pressure, so that leakage will be *into* the system rather than out.

Maximum allowed leakage is 0.02 cfh of gas per 100 cu ft of enclosed space at a negative pressure of 2 in. WG. This is only 0.02 percent of the gas in the system per hour. Leaks are detected using helium sensitive mass spectrometer leak detectors. The regenerative purifying circuit was designed to remove about 10 times this amount.

Seal Work Areas Against Radiation Hazard

Portions of the building where radioactivity may be present are completely sealed to the outside. The building's three working zones—administration, technical, and fabrication—are divided according to use and possible radiation hazard. Each is completely sealed from the other, the only access between areas being by means of an air lock.

Humidity controlled air is supplied to each of the three main operating areas by a separate air conditioning system. Replaceable filters are used on the supply air system to two of the areas.

Four types of work will be carried out:

1) Fabrication of work directly on plutonium fuel cores for nuclear reactors

2) Assembly, welding, and bonding of previously fabricated plutonium cores into nonradioactive jacket materials

3) Metal working, machining, cutting, or heat treating operations on the jacketed pieces

4) Inspection or other operations on finished fuel elements for which no protection is required.

Three Types of Exhaust Systems

Exhaust ventilation of the fabrication area includes three types of systems:

1) A once-through system for exhausting air from the process enclosures where work is done on reactor fuel pieces

2) An emergency standby or purge system which operates constantly and which, in event of failure of the normal ventilation, is automatically opened to provide ventilation of the process enclosure

3) A once-through filtered air system to exhaust the room air and to ventilate auxiliary equipment housed

High efficiency filters remove contaminants from exhaust air

in secondary enclosures below the primary process enclosures.

Keep Air Moving Inward

To prevent airborne radioactive dust from spreading between areas of the building, air is kept moving inward. Thus, there is no leakage from the technical area to the administration area or from the fabrication room to the technical area—even when air locks are opened. This is accomplished by keeping the technical area at a lower pressure (0.05 in. WG lower) than the outer atmosphere, and the fabrication room, where radioactive dust is most likely to originate, at a still lower pressure (0.125 in. WG lower than atmospheric). The administration area is kept at approximately atmospheric pressure.

What Is Plutonium? Why Is It Hazardous?

PLUTONIUM does not occur in nature, but is produced from Uranium 238, the abundant isotope of natural uranium, by a series of nuclear reactions. After chemical isolation from the uranium in which it is formed, the halides can be reduced to metal by methods analogous to those used for uranium. The metal has unusual and quite undesirable physical properties and is usable as a power reactor fuel only if diluted with considerable nonfissionable material, either fertile (such as Uranium 238 or Thorium 232) or inert (such as aluminum, zirconium, or oxygen) in nature.

The best use appears to be as fuel in a fast power breeder which not only produces power but also makes more plutonium than it burns. However, such reactors require moderately concentrated fuel and an investment of several hundred pounds of plutonium per reactor. Plutonium can be used as fuel in thermal reactors.

The hazards of working with plutonium are a consequence of four properties of the element:

1) Plutonium has the property of criticality (critical mass) with respect to neutron multiplication and nuclear fission.

2) It is a strong emitter of alpha particles.

3) Under certain circumstances, it may constitute a radiation hazard.

4) In some forms, it is pyrophoric, combining spontaneously and energetically with oxygen and producing sufficient heat to ignite combustible materials in its environment.

The Fuel Fabrication Facility is designed to allow maximum control of these four hazardous properties.

Filter All Exhaust Air

All of the air exhausted from the building is filtered through AEC high efficiency fire resistant filters. These are tested to be effective against 99.95 percent of all 0.10 micron size particles before installation. Double filter banks in series remove contamination from the air exhausted from all highly contaminated areas. Single filter banks are employed for room air exhaust. In addition to double filtration, all of the air exhausted from contaminated zones is piped through a 100 ft high stack at the south side of the building. This allows dissipation of any gaseous radioactive process products that may remain to a value well below the maximum permissible limits.

The helium ventilating atmosphere for the glove boxes is drawn through two high efficiency, fireproof, filter chambers at the outer end of the hood line. The filtered atmosphere passes through the filter housing and is then delivered to a ventilation duct extending through the lower longitudinal hood member. It is then discharged into each glove box through slots just above the glove box floor. Adjustable valves are used to regulate the supply of ventilation gas to each module.

Exhaust atmosphere is withdrawn from the hoods through slots equipped with adjustable covers on the upper longitudinal extrusions and discharged through a common exhaust duct to a 12×12×6 in. high efficiency filter located in another filter chamber.

Manually set dampers regulate the flow through the hood line and control the pressure within. Automatic controls isolate the glove box line from the helium gas recirculating system in case of an atmospheric break and open emergency purge ventilation valves. All filter changes are made from within the glove boxes to prevent spread of contamination to the room.

Standby Ventilation Systems Required

Safe operation of the glove box lines and the requirement of standby ventilation during filter changes made it necessary to have two completely separate standby ventilation systems. It was determined early in the design studies that these should be capable of high volume purging of the hoods in case of breaks in the main hood barrier. Each of these systems consists of a prefilter and final filter system in the fan loft and an exhauster capable of handling approximately 3000 cfm of air.

Gas-filled copper tubing is backbone of fire warning system

One standby system is connected by a 20 in. diameter duct to each hood line along one main section through a 10 in., gas-tight, rubber lined butterfly valve. The other standby system is connected to another section. These systems are opened when the pressure in any connected hood line rises above the normal operating pressure. They provide a regulated flow of 500 cfm of air through any opening up to 6 sq ft formed in the hood line. If an opening larger than this is formed, a full 3000 cfm of air is exhausted.

At the same time one of the standby ventilation systems is opened, valves in the helium supply and return line are automatically closed so that the helium recirculating system is not contaminated with air.

Change Gloves, Filters Without Opening Boxes

To prevent contamination of the room, techniques have been devised for changing gloves and filters and for moving items into and out of the glove boxes without opening them. An object to be transferred is placed in a heavy vinyl pouch gasketed to a port through the wall of a hood. Three dielectric heat seals are made between the port and the object. The center seal is cut, separating the envelope containing the object to be removed from the glove box line. This leaves a somewhat shorter closed pouch still attached to the glove box line ready for the next transfer. This technique prevents contamination of the room and leakage of air into an inert gas filled glove box. It also provides a small balloon of inert atmosphere for those items which cannot be exposed to the air.

In spite of these provisions, a slight loss of helium will occur when objects are admitted or removed from the process hoods. However, the loss of helium is estimated at only 200 to 400 cu ft per week of operation, depending partly on this introduction and removal.

Turbo-Compressors Pump Helium Gas

Pumping helium gas presents several problems not encountered with heavier gases. Helium is approximately one-seventh as heavy as air, and therefore it cannot be pumped by a standard centrifugal fan designed for air. The recirculating blowers of the Fuel Fabrication Facility are seven-stage turbo-compressors which, at 3500 rpm, will handle approximately 1000 cfm at a pressure head of about 0.5 psi. These units are used with an aftercooler.

Crossover connections and valves are provided so that:

1) One blower can be used while the other stands by,

2) Both blowers can be used in parallel to move up to 2000 cfm of gas, or

3) Both blowers can be used in series, with the aftercooler of the first becoming an intercooler between the two blowers. When used in series, the blowers can produce a differential pressure of approximately 1.15 psi at a delivery rate of 1000 cfm. In addition to the 12×12×6 in. high efficiency filters at each hood line, two 24×24×12 in. high efficiency filters are provided in the main return line to refilter all of the gas in the recirculating system before it reaches the turbo-compressors.

The purifying circuit consists of the following: A two-stage sealed compressor raises the helium pressure to 165 psi. The heat of compression in two stages will raise the temperature of the gas to approximately 788 F, so an intercooler and aftercooler are provided to bring the gas down to room temperature. The cooled helium is then passed through drying towers where almost all moisture is removed. After passing through the drying towers, the gas is piped to a cold exchanger where it is cooled to −40 F by evaporation of refrigerant No. 12 gas. The helium is then passed through four activated carbon towers in series.

Provision has been made to cool the gas from the carbon towers to liquid nitrogen temperatures and to pass it countercurrently through gas to gas heat exchangers located between the carbon towers. This provides the necessary low temperatures required for startup operations with impure gas. Regeneration of the activated carbon towers is accomplished by valving the main flow of helium to an alternate set of carbon towers and then evacuating the original towers, thereby clearing them of oxygen. Provision is made to pipe a small flow of hot helium to the towers from the compressor when hot regeneration or defrosting is required.

Pump Cooling Water Under Negative Pressure

Many of the processes involved in fabricating the plutonium fuel elements require cooling water and since the hooded enclosures are gas tight, leakage of a conventional positive pressure water cooling system would result in flooding of the hoods which in turn would increase the possibility of a nuclear accident, chemical explosion,

Why Helium Was Chosen

Besides its inertness, helium possesses a number of characteristics which make it especially useful in a plutonium experimental facility:

1) It has a high heat capacity and excellent heat transfer characteristics,

2) It is amenable to purification by regenerative physical means,

3) Highly sensitive techniques are available for determining leaks in a helium filled system.

CONSTANT checking for leaks prevents excessive helium escape. Loss of helium is only 200 to 400 cu ft per week of operation

and spread of contamination. A negative pressure pumping system in which the cooling water is pumped (or sucked) at subatmospheric pressure is provided to prevent this occurrence.

To establish a subatmospheric flow, a water jet eductor utilizing the kinetic energy in one liquid flow circuit is used to cause flow in another. Two turbine pumps supply the actuating liquid at a pressure drop of approximately 100 psi across two eductors. The eductors entrain approximately 13 gpm of water each at 70 F and at a suction lift of 20 in. Hg.

Recirculation water is passed through a packaged liquid chiller capable of removing 250,000 Btu per hr from the coolant. Entrained gases are vented to a filtered air exhaust system.

Provide Unique Fire Warning Device

A plutonium metal fire cannot be fought with water because water in contact with hot reactive metals releases large amounts of hydrogen which can result in a secondary explosion. Exclusion of air seems to be the only effective fire fighting procedure which has been developed to date.

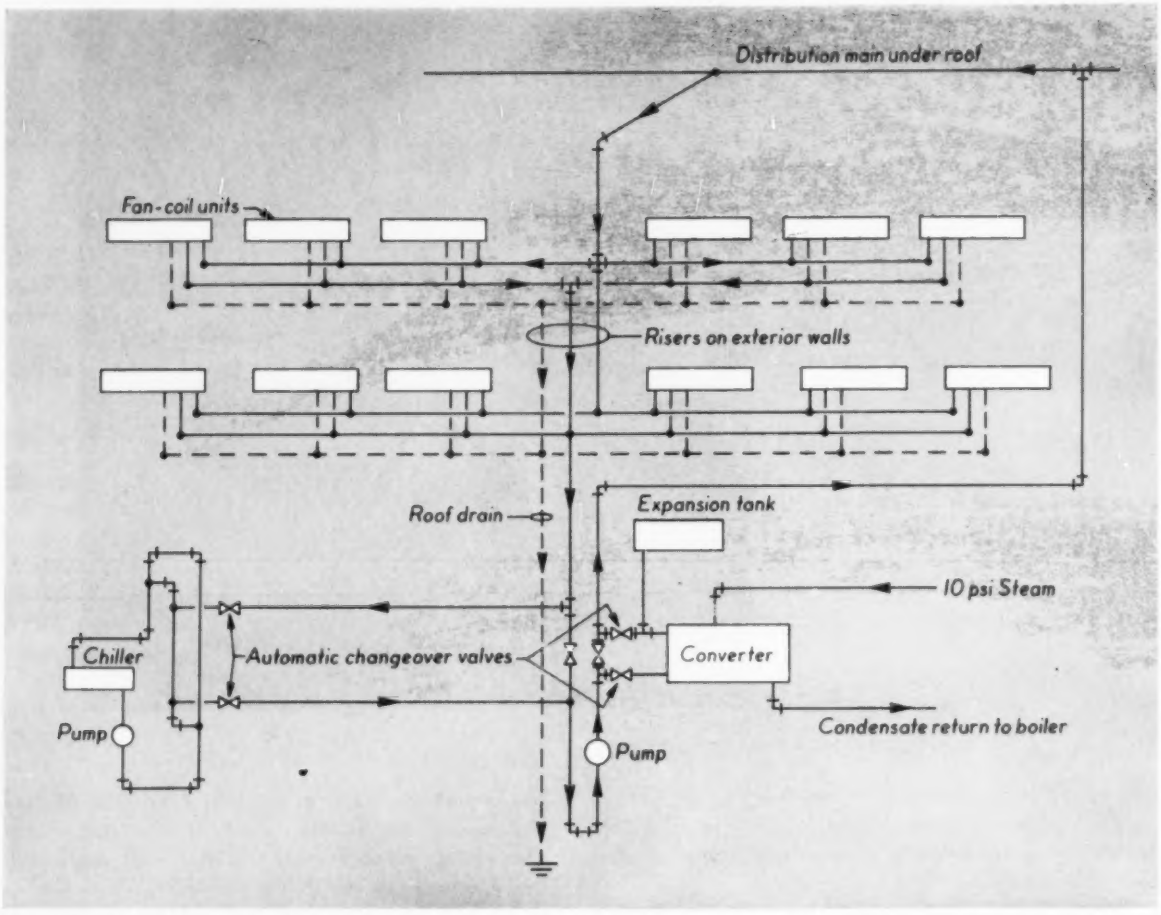
Because fire is a serious hazard in a plutonium facility, an effective fire warning device was considered essential in each glove line of the Fuel Fabrication Facility. A pneumatic temperature rise rate detector was selected. The system installed consists of thin wall copper tubing passing in a loop below the ceiling of each glove box line through seals in the ends of the line. The tubing then passes in a loop through the housing below the glove boxes.

Gas in the tubing is allowed to escape at a calibrated rate as it expands under normal changes in temperature. In case of fire, the expansion of gas is so rapid that it cannot escape the tubing. The increased pressure closes a bellows switch which sounds the fire alarm. Each hood line is so equipped.

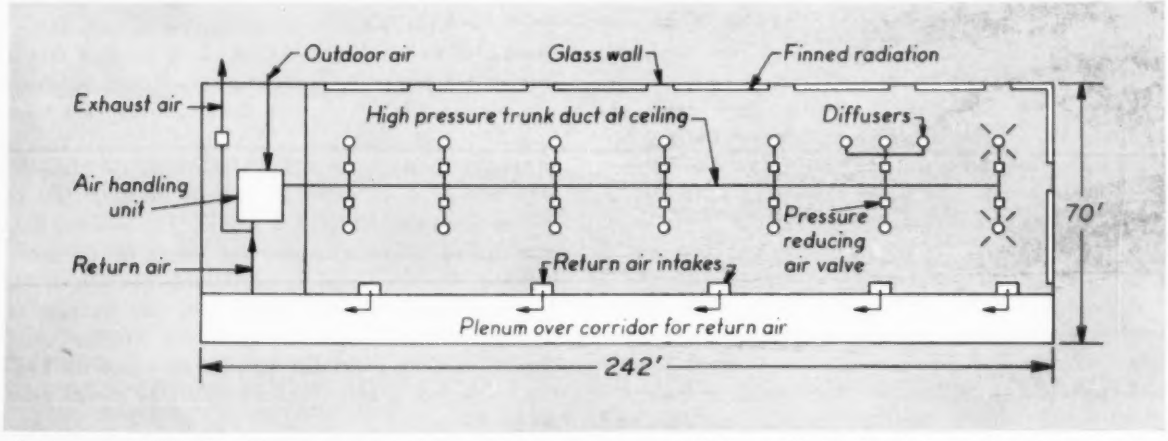
Storage vaults for radioactive materials are provided with tubing on the underside of each alternate shelf as well as below the ceiling of each vault. The system is also extended to laboratory rooms and offices of the entire building. The fire signal operates alarms throughout the building; panel indicator lights show the location of the fire. Relays transmit signals to the Argonne plant security and fire protection departments where the location of the fire is indicated immediately by a code print out machine.

Northwestern Heating & Plumbing Co. installed the piping systems, and Bloomer Heating & Ventilating Co. installed the duct and control systems. ≠

Fan-Coil Units' Flexibility Is Key



1 TYPICAL HEATING-COOLING ZONE (elevation view) consists of converter, expansion tank, pump, risers, returns. Supply risers extend to 12th floor ceiling. System features modulated hot water heating, chilled water cooling, automatic changeover



2 OFFICE BUILDING (plan view) is heated by forced hot water supplied to wall finned radiation under windows and to air handling units in fan room on second floor. Radiation satisfies about 35 percent of heating load; air handling units accommodate remainder, delivering tempered and humidified air at ceiling level via trunk duct to branches extending toward walls

To Heating, Cooling Plush Apartment

● The need for a wide range of comfort conditions to suit many different types of occupancy led to the decision to use fan-coil units for heating and air conditioning this new apartment-hotel-office building near Philadelphia. These units, with controls to satisfy the comfort whims of the individual occupant, are supplied with hot water in winter and chilled water in summer.

BY GEORGE A. INNES
Innes Associates
Engineers and Consultants

IN PLANNING for the heating and air conditioning systems in the new Benson-East luxury apartment-hotel-office building in the Philadelphia suburban area, many different types of occupancy conditions had to be considered:

1) A total of 286 apartment suites ranging in size from two and one-half to six rooms

2) Twelve stories above grade, two stories below grade, and 26,000 sq ft on each floor

3) A first floor consisting of shops, a bank, stores, offices, and a restaurant and kitchen

4) A first floor below grade consisting of commercial areas, a swimming pool, a health club, laundries, storage facilities, a restaurant dining room and second kitchen, and the upper part of the boiler room

5) A second floor below grade consisting of commercial areas, storage areas, the boiler room, mechanical equipment for restaurants, and the connection to a two-story office building

6) The 12th floor serving as general office space

7) The second floor serving as individual office spaces and transient guest rooms.

Because of the wide range of comfort conditions that had to be controlled, considerable study was devoted to the problem and how all these different areas could be served by a central system.

Finally, it was decided that fan-coil units should be used in the apartments, office spaces, and commercial areas, as they would provide the desired flexibility in room arrangements. It was necessary that these units be equipped with an adequate control system so that they would function satisfactorily. If proper controls were not provided, considerable difficulty could be experienced in supplying the correct hot water temperature to heat the space. Also, the space could be overcooled during the summer because of the constant 45 F chilled water delivered to the unit. Since occupants vary in their desires for comfort, individual control was a must.

With hot water required for these fan-coil units and process steam needed for the restaurant, health center, and swimming pool, it was decided to use low pressure steam boilers with steam supplied to converters for supplying hot water for heating.

4 Apartment Heating Zones

Four zones are provided for heating the apartments and one for the commercial areas. Each zone consists of a steam-to-water converter, expansion tank, pump, risers, and returns. Supply risers extend to the 12th floor ceiling, distribute laterally to the outside walls and then down to the basement, as shown in Fig. 1.

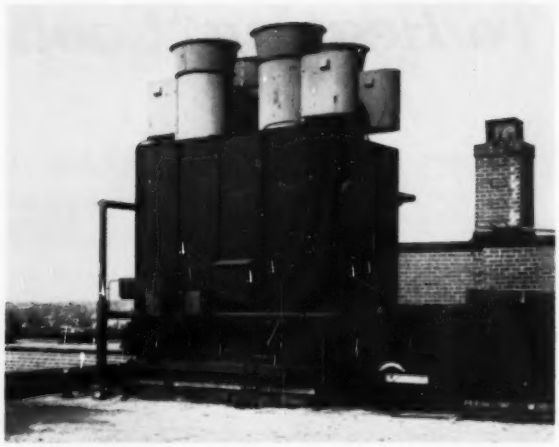
Return risers extend down the outside walls to returns in the basement. Supply and return laterals to the fan-coil units are under the floor in between the bar joints. Condensate is piped to the roof drain risers on the outside walls. The fan-coil units in each space recirculate 100 percent of the air. There are no outside air intakes through the exterior walls.

Tempered and humidified outside ventilation air is supplied to the apartments by three large air handling units in roof penthouses. Air is delivered from these units vertically down separate air shafts and is then discharged at 6000 cfm into the corridors at three locations on each floor. During the summer the coils in these units are supplied with chilled water to precool the outside air being admitted.

Each apartment door has an inlet louver for admitting ventilation air. Each bath and kitchen is equipped with exhaust fans that deliver the air to a shaft rising through the building to a large exhaust fan on the roof for each shaft. The air quantity exhausted from each floor in the apartment areas is 8000 cfm.

Special areas—the bank, for example—have their own heating and air conditioning units with outside ventilation air temperature electronically controlled in accordance with outside temperature. The restaurant areas have their own multizone units distributing tempered and cooled air through a pressurized suspended perforated acoustical ceiling. Finned radiation under the windows

INSTALLATION of fan-coil units was simple since all pipes, valves, electrical lines were roughed-in beforehand. All that was necessary was to put unit in place, hook up lines



COOLED AIR from rooftop cooling towers is sent to hallway outlets. From these it enters individual apartments through hallway door louvers to be further conditioned by room units

provide most of the heating for the restaurant areas.

800 Ton Cooling Capacity

The installed refrigeration capacity consists of two centrifugal compressors rated 400 and 300 tons, respectively, and one 100 ton reciprocating compressor. The centrifugals provide the comfort cooling capacity for the apartment and commercial areas, and the 100 ton unit supplies chilled water for the restaurant areas in the summer and chilled ethylene glycol for an outdoor skating rink in the winter.

Chilled water is circulated through a common header. A system of primary and secondary pumping is used for distribution of both the chilled and hot water for each zone. Automatic changeover valves permit either chilled or hot water to be delivered to the fan-coil units, depending upon the outside temperature.

Roof-mounted cooling towers consist of multiple 50 ton unit forced draft cells in a common bank with a common receiving tank. Cooling tower fans are thermostatically controlled in accordance with a preset water temperature in the return line.

Another cooling tower is located in the garage for the 100 ton compressor which also acts as an exhaust fan for the garage when required. This fan also ventilates the boiler room through a system of ductwork and bypass dampers. This air is exhausted at the parking deck level after passing through a silencer.

A cooling coil in the discharge duct dehumidifies the air during the winter so that it is relatively dry when it strikes the cold outside air, thus preventing fog and condensation on the building exterior.

Hot Water Heats Office Bldg.

The two-story office building connected to the Benson-East apartment-hotel is heated by a separate 50 hp oil fired boiler supplying forced hot water to finned radiation under the windows and to air handling units in the fan room on the second floor. The radiation satisfies about 35 percent of the heating load and provides a constant source of warm air over the glass walls on two sides of the building.

Air handling units accommodate the remaining portion of the heating load. Each floor is supplied from a separate air handling unit located in the fan room. The fan room is at one end of the building.

Tempered and humidified air is distributed at the ceiling level through a high pressure trunk duct in the center of the building with branch ducts extending out toward the walls. At each branch the pressure is reduced by a pressure reducing air valve. Return air intakes are on the wall next to the corridor and are connected to vertical ducts which permit the air to enter a plenum over the corridor ceiling and then pass to the fan room.

The first floor and second floor units deliver 16,000 and 19,000 cfm, respectively. These units have one water coil which serves for both heating and cooling. The air temperature leaving the coils is 105 F in the winter, and 62 F in the summer. About 35 percent of the air circulated is outside air, while only 25 percent of the air circulated is exhausted. Therefore the building is under a slight pressure at all times.

When erected, the building was not partitioned, because the owners could not determine how the space was to be rented. The entire space was considered as a single zone. Provisions had to be made for the air distribution to any and all divisions that might occur. Hence, the high pressure trunk duct was designed to supply varying requirements by adjusting the pressure reducing valves and the dampers at the air diffusers. Chilled water is supplied from the main building water chillers.

The mechanical (heating, piping, and air conditioning) contractor was H. C. Wahl Co. George S. Idell was the architect. ±

Photos courtesy American Radiator & Standard Sanitary Corp.

Computer Program KO's Stress Problems

. . . in designing high temperature piping systems

• The need for a shortcut to manual calculation of piping stresses has nurtured the development of a new program using a small, relatively low cost computer, the Bendix G-15D, to speed up this laborious task. Through this program, analyses that previously required hours—even days—of computation are now completed quickly and easily.

Mr. Ellis learned his pipe stress analysis under S. W. Spielvogel at ASME headquarters. In his 20 odd years of practical experience in piping, he has been associated with Lummus Co., the Solvay Process Div. of Allied Chemical Corp., and Giffels and Vallet prior to joining Reynolds, Smith, and Hills. Miss Schmidt earned her AB in mathematics from the University of California in 1956, graduating Phi Beta Kappa. Holder of a BS degree in mathematics from Jacksonville University, Mr. Watkins is currently a programmer at the Goddard Space Flight Center in Washington, D.C.

BY H. B. ELLIS
Piping Stress Analyst
NORMA SCHMIDT
Mathematician
and
EDWARD R. WATKINS
Mathematician
Reynolds, Smith, and Hills
Architects and Engineers
(Computer Service, Inc.)

HERE'S a small computer with a built-in appetite for problems peculiar to pipe stress analysis. Computer time for piping systems having several anchors in space has, in some instances, been limited to a single working day. Conversely, preparation of entry data for such complex problems will usually far exceed computer time. Some problems of wider scope and unusual configuration will, of course, require the additional features available in a larger more expensive unit.

The necessity of having to analyze main steam, reheat, and other complex high temperature piping systems initiated our search for a computer especially adaptable to piping flexibility analysis.

The basic questions were:

1) Can the pipe stress problem be reduced to a computer problem?

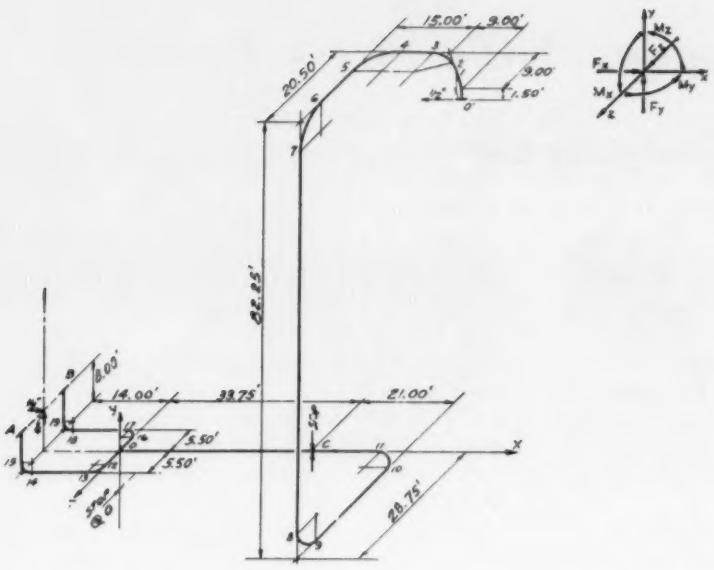
2) Can it be programmed economically for a small computer and be generalized enough to be of value?

The pipe stress problem contains many routine and straightforward calculations which are ideally adapted to a computer program, i.e., computation of shape coefficients, addition and multiplication of matrices, and solutions to sets of simultaneous equations. Manual calculations of these routine computations take a great amount of time, while a program could be written to take the entry data and perform the operations in a fraction of the time required using a desk calculator. From this point of view, it is ideally suited as a computer problem. For such a variable problem as pipe stress analysis, it was believed the computer would still come out far ahead of a manual calculation, even if the program were written in such a way that the analyst or operator made certain manual commands as the calculation progressed.

The economical programming of this problem was the next big question. In the low cost computer range, flexibility of the computer was an important factor to be considered for the solution of this problem. A study indicated that the Bendix G-15D would fill the bill. This computer would allow simplified programming making use of the interpretive systems, provide standard subroutines, and would be very easily adaptable to the necessity of manual commands at various points of the stress analysis problem. Subsequent use of the program has fully justified selection.

Only 2 Percent Error in Solution

Prior to programming the *General Analytical Method* developed by The M. W. Kellogg Co. and described in its manual *Design of Piping Systems*, an investigation was made to determine what order single precision matrix could be solved utilizing Cholesky's method. As opposed to double precision, this introduces an error of approximately 2 percent in the solution of the general matrix of performance. Considering the uncertainties inherent in any theoretical development, this accuracy is very satisfactory. It was our desire to avoid having to invert and reinvert matrices, with the involved "housekeeping" entailed, and to solve directly as large a matrix as possible.



1 PIPING CONFIGURATION for calculation No. 5.9 in *Design of Piping Systems* shown at left. Results of computation are listed in Table 1 at bottom of page

Illustration courtesy M. W. Kellogg Co.

This study revealed that one of order 39 could be formed, stored, and solved, and that the problem could be composed of a maximum number of 11 branches with a seven-anchor problem. As piping systems previously analyzed had contained not more than five space anchors, we were confident that most problems encountered could now be successfully solved. Having established the maximum general performance matrix, the remaining program became essentially one of "making a quilt from several patches." One "patch" was calculating the shape factors for each straight or curved member. Another "patch" was to arrange all the shape factors for the members comprising a branch of the system into a symmetrical 6 × 6 matrix.

To complete the "quilt" and "de-bug" it required approximately 750 hours of mathematician-programmer time. This is roughly equivalent to the cost of having one complicated system analyzed by business concerns offering this service. The stress analyst charted the course to be followed and decided what simplifications could be made to reduce computing time without significantly affecting the accuracy of the results.

TABLE 1 — RESULTS OF COMPUTATION for piping configuration shown in Fig. 1 are listed below

	M. W. Kellogg	Bendix G-15D	Ratio
$M'xa$	−5937.00	−5935.00	0.99
$M'ya$	854.00	877.00	1.03
$M'za$	−3495.00	−3914.00	1.12
Fxa	−800.52	−874.85	1.09
Fya	812.90	852.27	1.02
Fza	−24.58	−33.57	1.37
$M'xb$	−6308.00	−6321.00	1.00
$M'yb$	650.00	643.00	1.02
$M'zb$	−2057.00	−2217.00	.84
Fxb	1765.41	1861.70	1.05
Fyb	−1728.80	−1764.20	1.02
Fzb	94.49	88.82	.94
Fzc	494.45	542.91	1.09
Fyc	4086.63	4159.00	1.02
θxc	0.00927	0.0091	
θyc	0.00026	0.0003	
θzc	−0.00121	−0.0012	
δxc	0.390′	0.396′	
δyc	0.0000′	0.0002′	
δzc	−0.021′	−0.015′	
θxa	0.00306	0.0031	
θya	−0.00013	−0.0002	
θza	0.00148	0.0015	
δxO	0.145′	0.143′	
δyO	−0.021′	−0.021′	
δzO	0.0000′	−0.0001′	
$S'e$ @ 8	4968.00 psi	5045.00 psi	1.01
$S'e$ @ O	2072.00 psi	2121.00 psi	1.02

Outline Procedure Followed in Program

Here is a brief outline of the procedure followed in our program. It is offered as supplementation to the flow sheet for clarity.

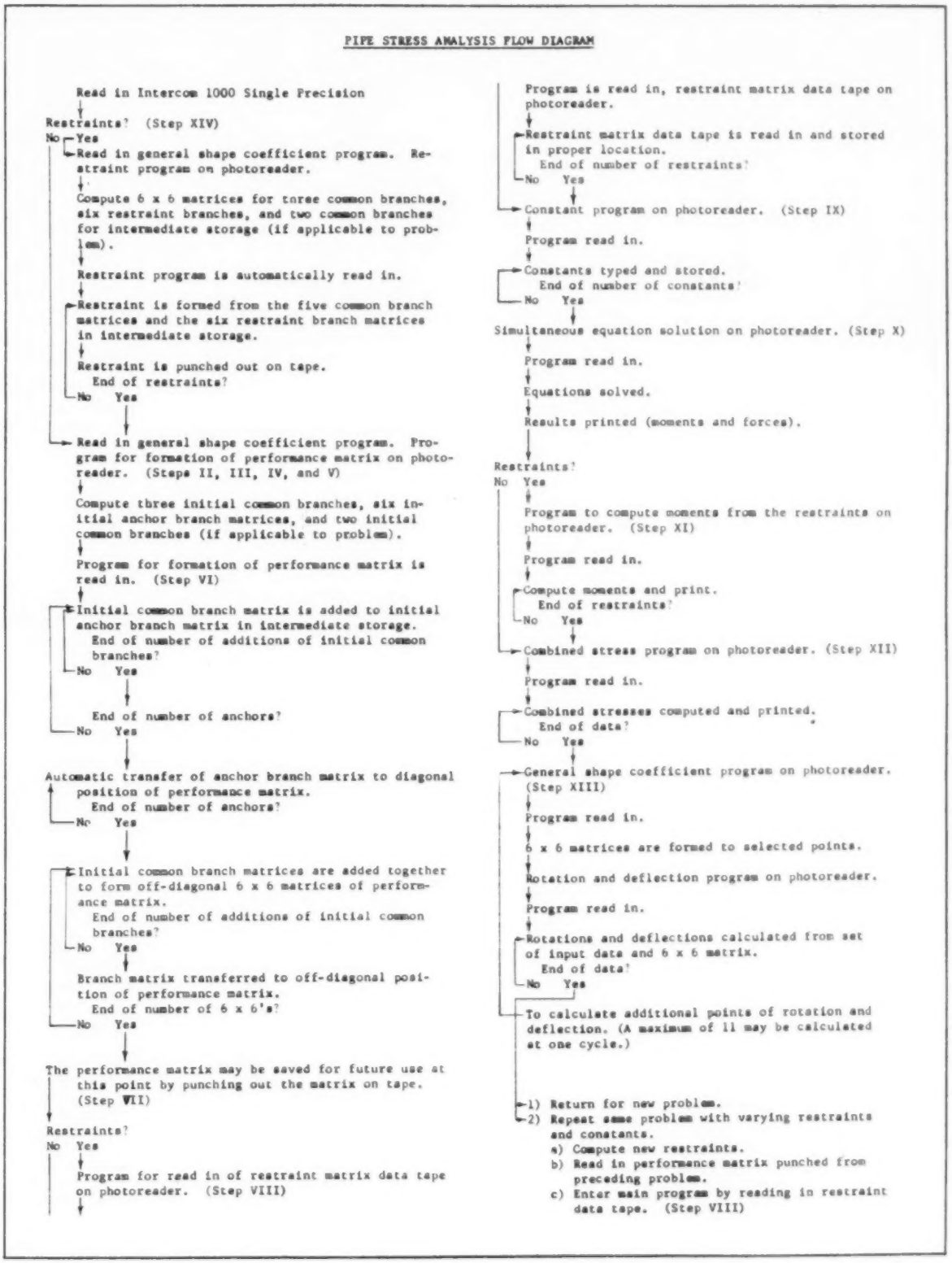
1) Prepare an isometric sketch and a matrix of performance for the entire system.

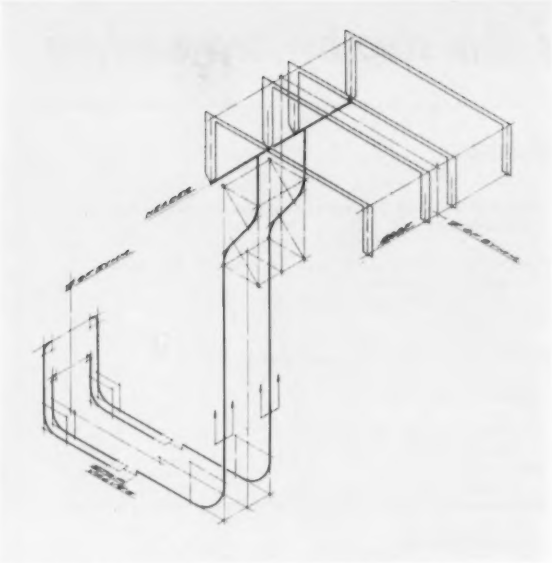
2) The pipeline is then formed into working planes and the necessary information to be used as entry data is calculated and entered on a standard form sheet containing 12 columns and 36 rows. The column headings are: member, plane, straight, curved, k, Q, R, φ, L, a, b, c, and α.

3) Plot the step-by-step procedure for each problem before starting computation. Limits of integration may be sketched out to aid in deciding which branches, if any, depending on scope of problem, have to be added together, and where branch matrices shall be stored both prior to, and in forming the general performance matrix.

4) Enter data from the form sheet for each curved and or straight member. The computer transforms this data entered into shape coefficients for each member.

Each pipe stress problem follows this step-by-step analysis


PIPE STRESS ANALYSIS FLOW DIAGRAM
Read in Intercom 1000 Single Precision
Restraints? (Step XIV)
No
Yes
Read in general shape coefficient program. Restraint program on photoreader.
Compute 6 x 6 matrices for three common branches, six restraint branches, and two common branches for intermediate storage (if applicable to problem).
Restraint program is automatically read in.
Restraint is formed from the five common branch matrices and the six restraint branch matrices in intermediate storage.
Restraint is punched out on tape.
End of restraints?
No Yes
Read in general shape coefficient program. Program for formation of performance matrix on photoreader. (Steps II, III, IV, and V)
Compute three initial common branches, six initial anchor branch matrices, and two initial common branches (if applicable to problem).
Program for formation of performance matrix is read in. (Step VI)
Initial common branch matrix is added to initial anchor branch matrix in intermediate storage.
End of number of additions of initial common branches?
No Yes
End of number of anchors?
No Yes
Automatic transfer of anchor branch matrix to diagonal position of performance matrix.
End of number of anchors?
No Yes
Initial common branch matrices are added together to form off-diagonal 6 x 6 matrices of performance matrix.
End of number of additions of initial common branches?
No Yes
Branch matrix transferred to off-diagonal position of performance matrix.
End of number of 6 x 6's?
No Yes
The performance matrix may be saved for future use at this point by punching out the matrix on tape. (Step VII)
Restraints?
No Yes
Program for read in of restraint matrix data tape on photoreader. (Step VIII)
Program is read in, restraint matrix data tape on photoreader.
Restraint matrix data tape is read in and stored in proper location.
End of number of restraints?
No Yes
Constant program on photoreader. (Step IX)
Program read in.
Constants typed and stored.
End of number of constants?
No Yes
Simultaneous equation solution on photoreader. (Step X)
Program read in.
Equations solved.
Results printed (moments and forces).
Restraints?
No Yes
Program to compute moments from the restraints on photoreader. (Step XI)
Program read in.
Compute moments and print.
End of restraints?
No Yes
Combined stress program on photoreader. (Step XII)
Program read in.
Combined stresses computed and printed.
End of data?
No Yes
General shape coefficient program on photoreader. (Step XIII)
Program read in.
6 x 6 matrices are formed to selected points.
Rotation and deflection program on photoreader.
Program read in.
Rotations and deflections calculated from set of input data and 6 x 6 matrix.
End of data?
No Yes
To calculate additional points of rotation and deflection. (A maximum of 11 may be calculated at one cycle.)
1) Return for new problem.
2) Repeat same problem with varying restraints and constants.
a) Compute new restraints.
b) Read in performance matrix punched from preceding problem.
c) Enter main program by reading in restraint data tape. (Step VIII)



2 THIS SYMMETRICAL ARRANGEMENT of a generator-turbine system required solution of 26 simultaneous equations. Individual superheater tubes were replaced by single member of appropriate stiffness—a permissible substitution due to symmetry

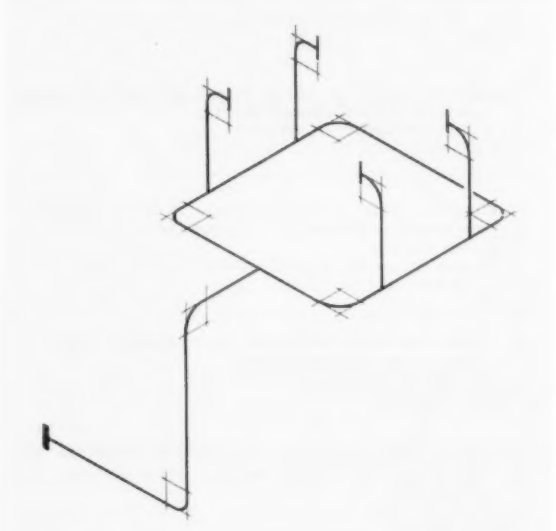
Following computation of coefficients for the last member in any given branch, the program automatically forms a symmetrical 6 × 6 matrix for that branch and places it in an intermediate storage area. Manual commands allow the operator to add any combination of 6 × 6 matrices together and to store them into any one or more of the 21 spaces of the symmetrical general performance matrix. Having formed and stored all branch matrices preparatory to a solution, a manual command sets a register to permit type-in and storage of the rotation and deflection constants in their correct locations. Upon entry of the last constant, the computer proceeds to solve the equation and prints out the values for internal forces and moments caused at the origin by each restraint. These values are manually added together to obtain the algebraic sum at the origin. Appropriate values are re-entered to obtain primary and secondary bending moments and torsional moments and combined stresses at any desired location. If rotations and deflections are to be calculated, up to and including eleven 6 × 6 matrices may be formed, one for each point at which rotations and deflections are to be determined. The program automatically cycles through the desired number of points and halts. If rotations and deflections at points exceeding 11 are to be obtained, it is necessary to form new 6 × 6 matrices, replacing those previously stored.

5) If the problem has one or more intermediate restraints, the matrices for these are computed first by an optional sub-routine and then punched out on tape for re-entry to the right of the anchor matrices in the general performance matrix. For example, each restraint introducing a single external force produces two moments at the origin of coordinates and the displacement equations involve the unknown rotations at the restraint. To maintain symmetry and delete the zeros on the principal diagonal of the general performance matrix, the two moments and the unknown rotations are eliminated in its solution. After the single force has been determined, the two moments at the origin due to the single force are obtained by manually typing in two distance factors.

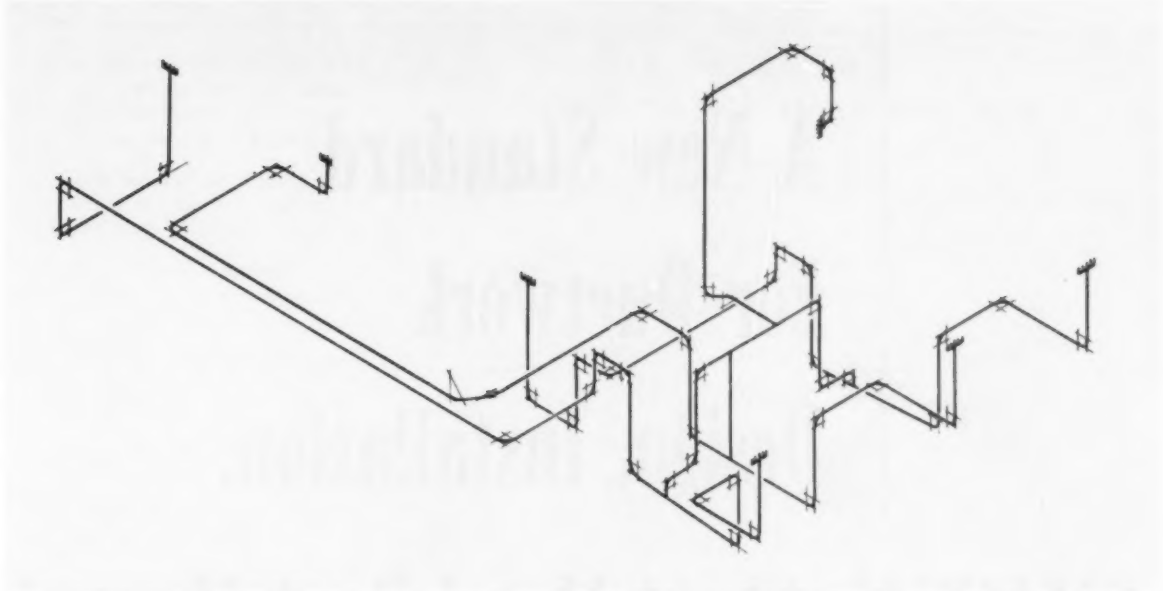
After the matrices for the intermediate restraints have been formed and punched out on tape, the matrices for the anchors are formed and stored in their correct location in the general performance matrix and also punched out on tape. Then the latter tape is read back in, the restraint tape is read in, the constants are entered, and the equation solved. If the solution indicates that the intermediate restraints should be relocated, merely form new matrices for the relocated restraints and punch them out on tape. The original anchor tape is read in again, the tape of the relocated restraints is read in, the constants entered, and the new equation solved.

6) Hinged ends are treated very similiarly to intermediate restraints. For a hinged end allowing rotation but not translation in the three planes, the primary matrix would be a 15 × 15, further reduced to a 3 × 3 expressing forces only. The moments which were eliminated to maintain symmetry of the general performance matrix are restored by multiplying each resulting force by two distance factors which restores the two moments at the origin due to each of the single forces.

7) Skewed members have their coefficients generated in an auxiliary plane to be later transferred to one of the three coordinate planes. In a branch, each group of skewed members which will be rotated around the same



3 THIN WALL, LARGE DIAMETER SYSTEM shown above was solved as a "square corner" problem and then with consideration given to high flexibility and stress intensification factors of its long radius elbows. Comparison of values obtained indicated that "simplifying assumptions" in this case were of doubtful value in predicting theoretically precise reactions



4 THIS MAIN STEAM SYSTEM for a marine power plant originally had its three boilers and three turbines installed on "unit system" basis. Later modification incorporated a crossover so that any boiler could supply any turbine and also supply steam to a shore installation. This further serves to illustrate magnitude of solution possible

axis is treated together. Any branch may contain an unlimited number of skewed members.

8) With regard to the flow sheet, we believe each step is self-explanatory with the possible exception of the terms *common branches* and *anchor branches*. This can best be explained by referring to Calculation No. 5.9 in the Second Edition of *Design of Piping Systems*. The branch extending from O' to C would be a common branch, as would the single member extending from C to O. The anchor branches are those extending from O to A and from O to B. Then, to form the integral with limits extending from O' to A, add the two common branches and the single anchor branch in a particular space of the memory alloted for this procedure. The result would be automatically transferred to its correct location along the principal diagonal in the general performance matrix.

What Saving Has Been Realized?

Since the program was motivated by the desire to drastically reduce the time required to solve any given problem, it now seems fitting to indicate that saving.

1) Shape coefficients for straight members are generated and stored in 20 sec.

2) This same information for curved members requires 30 sec.

3) A 6×6 matrix of shape coefficients is formed and transferred to temporary storage in 17 sec.

4) The method adds one 6×6 to another 6×6 in 53 sec.

5) Possibly the most interesting item to stress analysts who have solved their matrices on a desk calculator is the time required for simultaneous equations: a 12×12 matrix, 23 min.; an 18×18 matrix, 45 min.; a 24×24 matrix, 90 min.; and a 30×30 matrix, 190 min.

Table 1 lists the results of computation for Fig. 1 (Calculation No. 5.9 on page 153 of the Second Edition of *Design of Piping Systems*). It is pertinent to note here that, for our solution, the origin of coordinates was placed at the superheater outlet rather than at the junction of the turbine leads. In the First Edition, the origin was always located at one fixed end, and we arbitrarily selected the superheater outlet. This will further confirm the Kellogg Co.'s statement on page 102 of the Second Edition that the origin of the coordinate system may be at any point on or outside of the pipe line. Values for moments are rounded-off to eliminate digits to the right of the decimal, thus agreeing with the Kellogg procedure.

While the ratio in Table 1 tends to be misleading (as witness that for Fza in comparison with the magnitude of the forces), it nevertheless indicates the range of accuracy obtained with this computer.

To further illustrate the types of problems for which the program has been found suitable, three random samples of piping systems are shown in Figs. 2, 3, and 4.

A final note: While anyone with a reasonably good mathematical background can follow the intricacies of pipe stress analysis, only those who have encountered and defeated the pitfalls and snares lurking to trap the unwary can truly qualify to set up and interpret solutions of complex piping systems. The satisfactory result of any stress analysis program is predicated on the experience, comprehension, and judgment of the analyst.

The authors gratefully acknowledge their indebtedness to A. R. C. Markl and H. V. Wallstrom whose graciously extended aid has made this program possible.

A New Standard For Ductwork Design, Installation:

SMACNA's Sheet Metal Duct Manual

New tool for engineers, contractors will lift veil of confusion, misunderstanding

BY JAMES H. STIGGLEMAN
Chief Mechanical Engineer
Childs & Smith
Architects and Engineers

LAST MONTH's article describing the Sheet Metal and Air Conditioning Contractors National Association's new *Duct Manual and Sheet Metal Construction for Ventilating and Air Conditioning Systems* explained that the manual is divided into three basic parts. This article will concern itself with the second part, plates 15 through 58, covering fabrication of special sheet metal connections and shapes.

In general, these plates detail hangers, elbows, branches, tees, dampers, access doors, fire dampers, goosenecks and range hoods, belt guards, fan housings, hoods, and many others.

Every engineer has probably at one time required the use of most of these details—more than likely, all of them. Some are necessary on every ventilation system. These details are handled in many ways by different design engineers. Some cover them in specifications, others make special details to cover each specific job, others have their own file of standard details which they either trace or apply to the job by a reproduction process, and still others use a combination of all three. Unfortunately, there are also times, due to the urgency and speed required to finish a project or because a job is rather small, when these details are hardly covered at all.

There are problems connected with all the above methods. Unless an engineer has a good file of standard details, he can waste a lot of time working these problems out and drawing them. Even with standard details, unless the originals are reproduced photographically, it is time consuming to retrace them. It is also possible for a draftsman to make a mistake in retracing. These mistakes are often not caught, mainly because they were traced from standards

FIG. A – *ANGLE TRAPEZE TYPE HANGER WITH ROD SUPPORTS TO STEEL BEAM FOR HANGING SINGLE DUCTS.*
(Recommended for large size ducts.)

The bottom of rod is threaded, inserted in a hole in the angle and a nut is applied to hold in place.

The top of rod is welded to a "C" clamp which is screwed to the flange of the beam.

A 1/8 x 1 in. safety bar is welded to the "C" clamp, the end of which is hammered over the opposite flange of the beam to prevent the "C" clamp from slipping off. Note Detail.

Size of rod, angle and spacing will vary with the duct size.

FIG. B – *ANGLE TRAPEZE TYPE HANGER WITH ANGLE SUPPORTS TO WOOD JOIST*
(Recommended for large size ducts.)

The angle support is screwed into the wood joist and bolted or welded to shelf angle.

Size of angles and spacing will vary with the duct size.

FIG. C – *ANGLE TRAPEZE TYPE HANGER WITH ROD SUPPORT TO CONCRETE BEAM.*
(Recommended for large size ducts.)

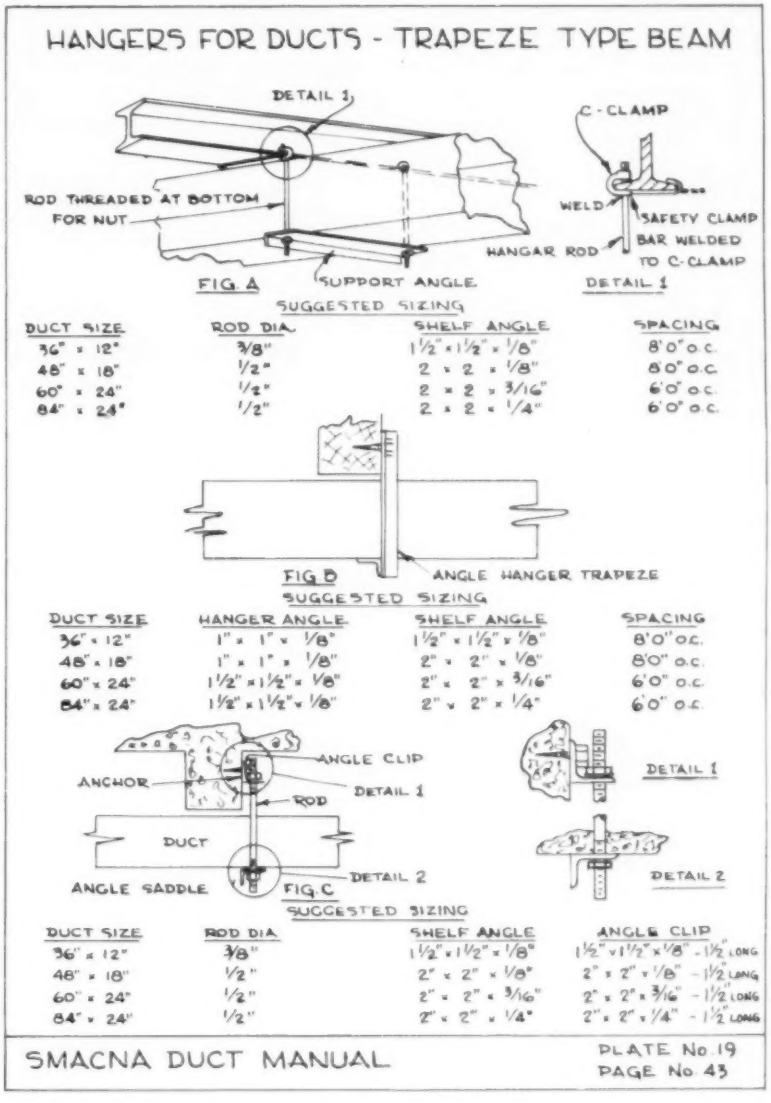
The bottom of the rod is threaded, inserted in a hole in the angle and a nut applied to hold in place.

An angle clip is installed on the side of the beam with an approved type anchor bolt or screw. The horizontal leg of the angle is drilled to receive the top of the rod which is threaded for a nut.

Size of rod and angle will vary with the duct size.

PLATE NO. 19

HANGERS FOR DUCTS—TRAPEZE TYPE - BEAM


HANGERS FOR DUCTS - TRAPEZE TYPE BEAM
DETAIL 1
ROD THREADED AT BOTTOM FOR NUT
HANGAR ROD
SUPPORT ANGLE
FIG A
C - CLAMP
WELD
SAFETY CLAMP BAR WELDED TO C-CLAMP
DETAIL 1
SUGGESTED SIZING
DUCT SIZE | ROD DIA. | SHELF ANGLE | SPACING
36" x 12" | 3/8" | 1 1/2" x 1 1/2" x 1/8" | 8'0" o.c.
48" x 18" | 1/2" | 2 x 2 x 1/8" | 8'0" o.c.
60" x 24" | 1/2" | 2 x 2 x 3/16" | 6'0" o.c.
84" x 24" | 1/2" | 2 x 2 x 1/4" | 6'0" o.c.
ANGLE HANGER TRAPEZE
FIG D
SUGGESTED SIZING
DUCT SIZE | HANGER ANGLE | SHELF ANGLE | SPACING
36" x 12" | 1" x 1" x 1/8" | 1 1/2" x 1 1/2" x 1/8" | 8'0" o.c.
48" x 18" | 1" x 1" x 1/8" | 2" x 2" x 1/8" | 8'0" o.c.
60" x 24" | 1 1/2" x 1 1/2" x 1/8" | 2" x 2" x 3/16" | 6'0" o.c.
84" x 24" | 1 1/2" x 1 1/2" x 1/8" | 2" x 2" x 1/4" | 6'0" o.c.
ANGLE CLIP
ANCHOR
ROD
DETAIL 1
DUCT
DETAIL 2
ANGLE SADDLE
FIG C
DETAIL 1
DETAIL 2
SUGGESTED SIZING
DUCT SIZE | ROD DIA | SHELF ANGLE | ANGLE CLIP
36" x 12" | 3/8" | 1 1/2" x 1 1/2" x 1/8" | 1 1/2" x 1 1/2" x 1/8" - 1 1/2" LONG
48" x 18" | 1/2" | 2" x 2" x 1/8" | 2" x 2" x 1/8" - 1 1/2" LONG
60" x 24" | 1/2" | 2" x 2" x 3/16" | 2" x 2" x 3/16" - 1 1/2" LONG
84" x 24" | 1/2" | 2" x 2" x 1/4" | 2" x 2" x 1/4" - 1 1/2" LONG
SMACNA DUCT MANUAL
PLATE No. 19
PAGE No. 43

which were not very carefully worked out in the first place.

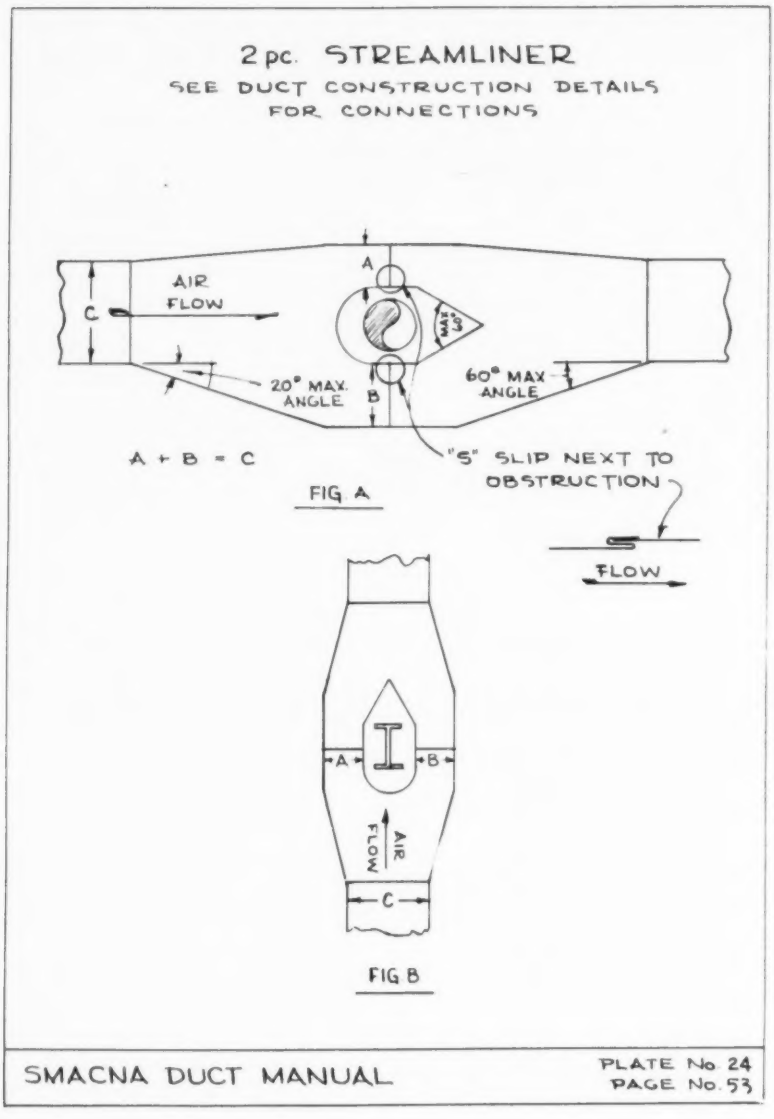
Using the duct manual also has the advantage that these details are acceptable to the contractors who are actually going to install the system. This fact alone should do away with the annoyances of being asked to change details on the job because of their not being standard in the industry.

It is not possible in this article to describe every plate from 15 through 58. However, a few of them warrant brief discussion. Each plate is accompanied by a complete detailed description on its facing page. There are, for instance, five plates covering hangers for ducts. These include ducts supported from walls and ceilings, horizontal and vertical ducts, ducts through floors, different sizes of ducts, and methods of hanging ducts from various constructions.

Plate 19, entitled *Hangers for Ducts—Trapeze Type Beam*, is reproduced above. The illustration and its accompanying descriptive material are so clear that they require no further explanation.

Plate 24, *Two Piece Streamliner*, is illustrated because it is unusual for an engineer to detail or even describe such a construction in much detail in his specifications. Many times this condition is not even an-

PLATE NO. 24 - TWO PIECE STREAMLINER



Where it is impossible to offset a duct around an obstruction such as a steam line, plumbing line or small beam, the obstruction must encompassed with a 2-piece "Streamliner" as shown on Plate No. 24.

The area of the duct must not be decreased. Dimension must equal the sum of dimension A & B.

The air entering side should taper on a maximum angle of 20 degrees and the leaving side should taper on a 60 degree maximum angle.

The Streamliner around the obstruction should be rounded on air entering side and tapered to a 60 degree point on the air leaving side.

The Streamliner is usually installed with an S Slip on the inside next to the obstruction for easy assembly.

The ends of a Streamliner are connected to the Tapers with Pittsburgh Locks.

The ends of the Tapers are connected to one duct with any of the standard joints normally used.

FIG. A – *NON-SYMMETRICAL*

As shown in Fig. A, the sides of a Streamliner need not be symetrical. It is important only that A plus B = C as noted above.

FIG. B – *SYMMETRICAL*

Fig. B illustrates a Streamliner design which uses perfectly symmetrical sides for overall appearance and where A = B. This design is frequently used for vertical exposed ducts which must encompass a beam.

ticipated, but occurs due to unforeseen interferences on the project and must be treated as a job condition. Through the manual, this problem can now be handled using good practice with no misunderstandings as to how it should be solved.

Plates 34 and 35 illustrate fire dampers and automatic fire doors. These are reproduced from pamphlet No. 90A of the National Fire Protection Association. These plates are included because pamphlet 90A is generally referred to in specifications but is not always at everyone's fingertips. Having these plates included in the manual should save time.

Another detail that sometimes is not given proper emphasis is the construction of access doors. Basically, there are only two types: insulated and uninsulated. The manual has two plates covering these. Another plate details inspection plates and test holes in ducts.

Plate No. 50, illustrated on the next page, shows construction details for both insulated and uninsulated doors. Indicated are gasketing and latches to provide access from both sides of door. Doors would be of the size specified by the engineer and optional features, such as glass inspection windows, can be added by specification. The sheet metal gage for the door will be selected by the

PLATE NO. 50

ACCESS DOORS FOR CASINGS

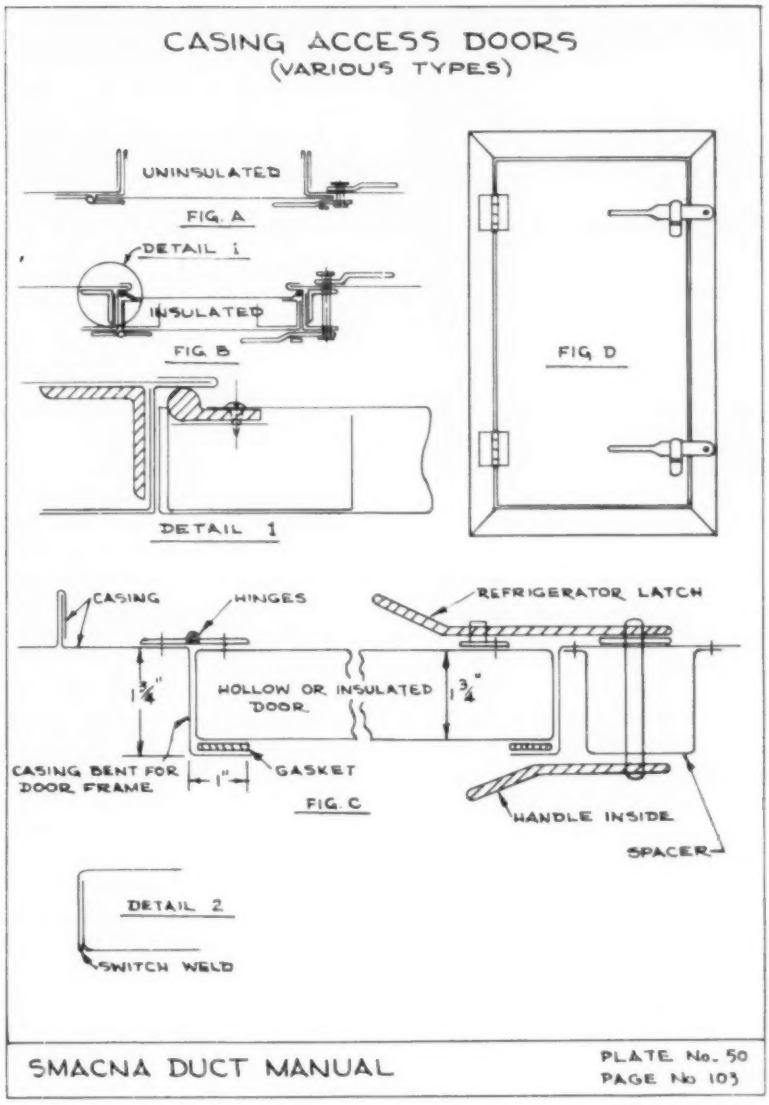


FIG. A – *CONSTRUCTION OF AN UNINSULATED DOOR*

The casing sheet is flanged inward and hemmed back to form the frame. The door is formed as shown to lap over the casing.
Hinges are installed on one side with latches on the other side, riveted or bolted in place. The gasket is installed on the door where door laps over the casing.

FIG. B – *CONSTRUCTION OF INSULATED DOOR*

The frame is formed separately and is locked to the casing as shown in "Detail 1". An angle is installed back of the frame, spot welded or riveted to the casing sheet, for reinforcing.

The door is made either of metal, filled with insulation, or it may be a wood core covered with metal.

The gasket is installed on the door as shown in "Detail 1".

Hinges are installed on one side with latches on the other side.

FIG. C – *CONSTRUCTION OF INSULATED DOOR*

The casing is flanged inward with a stop formed on inner edge to receive door. The gasket is installed on this stop.

The door is made of metal as per "Detail 2" and filled with insulation or it may have a wood core, covered with metal.

Hinges are installed on one side with latches on the other side.

FIG. D – *ELEVATION OF TYPICAL ACCESS DOOR SHOWING LOCATION OF HINGES AND LATCHES.*

Note: Latches should be of the wedge type to close doors tightly and with operating handles on both inside and outside of casings.

Hinges should have non corrosive pins.

engineer, based on the dimensions of the door and static pressure of the system.

It is not possible in this article to describe all of the details shown in the manual. However, this brief discussion should give some indication of its great value. The manual must be used with judgment and discretion. It is not meant to be a substitute for brains. It is, in fact, a very useful and helpful tool; however, an engineer cannot merely write in his specifications, "follow the manual." He must choose what he wants from the manual and modify, in some cases, those details to suit his particular conditions.

A future article will describe the third and last part of the manual, which is a suggested specification. This specification shows how to tie the manual's various details into the plans and specifications for a ventilating system so that full use and all the advantages of this tool can be realized. ⌗

Steam Metering, Billing Procedures Pay Off in U. of C. Heating Plant

. . . 30-year record of steam consumption costs, maintenance shows what sound engineering can do

BY LYMAN R. FLOOK
Formerly Superintendent of
Buildings and Grounds
University of Chicago

• Last month the University of Chicago's central heating plant had its 30th birthday. In the November issue, Lyman Flook, superintendent of buildings and grounds for the university for many years, related some of the physical details of this superbly engineered installation which, since 1929, has been and is still operating with its original piping and boiler tubes and has kept abreast of the steam needs created by university expansion. He continues here, highlighting the administrative and maintenance sides of the system's operation, showing what steam metering procedures have been used. He also explains the coordinated program that has been so successful in maintaining low steam consumption and in keeping the peak load on the plant low.

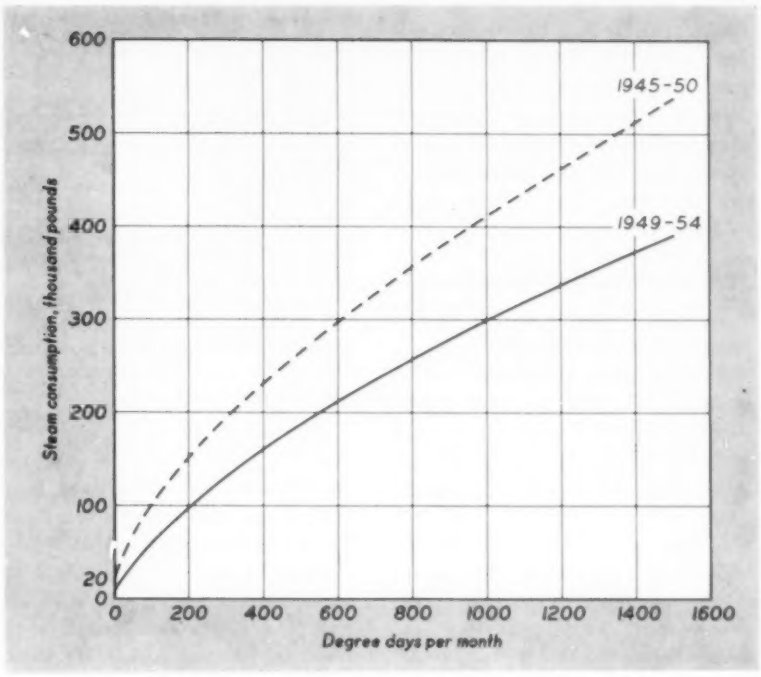
Mr. Flook, a 1913 civil engineering graduate from the University of Michigan, has had long experience in design, construction, operation, and maintenance of very large physical plants. Professional engineer, administrator, manager, lecturer, and writer, he was associated with the University of Chicago from 1919 to 1954, the year of his retirement. Since 1947, Mr. Flook has served in various special posts, most notably as construction manager for the U. S. Atomic Energy Commission's Argonne National Laboratory, near Chicago. In addition to his many professional society affiliations, he is a past president of the National Association of Physical Plant Administrators of Universities and Colleges.

THE University of Chicago's central heating plant, three decades old last month, continues to serve an expanded campus. Several of the physical modifications that have been made over the past 30 years that have enabled the system to keep pace with the steam needs of a growing university were outlined in last month's article.

Actual day-to-day plant operations—metering, billing, interest and depreciation—also play major roles in the success of this installation. Through diligent, accurate, reliable record-keeping, close administration of plant operation and maintenance is achieved.

An earlier article[1] described metering practices, meter testing, analyses of monthly steam use reports, annual operation, line losses, and billing practices as they then existed. As they were in 1936, records of factor "X," an index of steam used per degree day per 1000 cu ft of heated building, are still being used.

Curves plotting steam used against degree days are maintained for each point of service, whether that be a single building, a group of buildings, a submaster meter, or a master meter. Such curves accurately reflect the benefits of certain plant modifications: improved controls, added insulation, orificing to reduce radiation to heat loss, improved local piping, etc. For example, Fig. 1, plotting



1 CURVES plotting steam used *vs* degree days are kept for each point of service. Such records give proof of benefits of plant modifications. Curve at right, for the university's Culver Hall, illustrates how 1949-54 average is well below 1945-50

curves for a random university building, graphically illustrates that the 1949-54 average is well below the 1945-50 average for that particular structure—direct proof of the value of physical improvements.

The continued reduction and holding of low steam consumption[2] is more than mere operation of the facilities to generate and distribute steam. It requires the *informed* cooperation of its users. Finding new ways to conserve steam has become an ever-present goal of all consumers.

Since the university is made up of many divisions and subdivisions, efforts to conserve steam by individuals or local groups would result in considerable waste motion and confusion if not coordinated into some kind of organized program. Therefore the problem is studied by a special steam conservation committee of rotating membership appointed from several employment groups. The committee, which pursues its objective throughout the year, always includes the maintenance engineer of the local building or group of buildings under study and the departmental representative who has knowledge of the operation and sees the bills for heating and other steam uses.

Tours and inspections are regular and frequent. Where these inspections reveal methods to save steam or possible ways to improve service, written reports of the committee's recommendations are submitted. The cost for improvements is then weighed against the fuel cost for steam. Normally, where modifications will pay for themselves within five years, the recommendations are approved.

Over the years, reductions in steam use, while they have been tangible, have not been easy to come by. It has been only through the constant, intensive efforts of the university's operation and maintenance teams that they have been realized.

Four Control Applications

As new and better metering devices and controls have become available, their use became general. At present 53 buildings are provided with zone control and 34 have outside bulb thermostats for primary control. These controls and simple and inexpensive automatic timing devices are widely used throughout the university.

Four types of controls cover all but a few applications:

1) Individual room thermostats. (Some installed in 1892 are still in use.)

2) Duo-stats, or day-and-night stats to meet different schedules of classrooms, lecture rooms, etc.

3) Outdoor control of pressure reducing valves, principally for dormitories and apartments.

4) Outdoor control with seven-day program time clocks and minimum indoor stats, principally for classroom and office areas.

If the ancient argument that shutting off the steam at night is not economical is not yet settled in anyone's mind, the evidence can be found here. Night temperatures are usually set at 55 F or lower, and large savings are effected by lower steam consumption during non-use hours.

Billing Influences Conservation

The method of billing is a great if indirect influence in the continuing interest in steam conservation. For the budget, the unit cost for steam is estimated. Bills, based upon the meter readings, are rendered every four months. At the end of the fiscal year, when the budget balances of auxiliary activities (which have in-

come) are at low or less than low levels, a fifth bill is rendered to correct the estimated unit cost for the year's steam used to actual cost. In most years this has been a most welcome credit. Every effort is made to overestimate the unit steam cost, if ever so little.

Space Cooling Has Been Limited

The policy for many years has been against space cooling for classrooms and offices. The first cooled building[3], the offices of the Public Administration Clearing House, was opened in 1938. It uses a 100 ton compressor with one 125 hp electric motor.

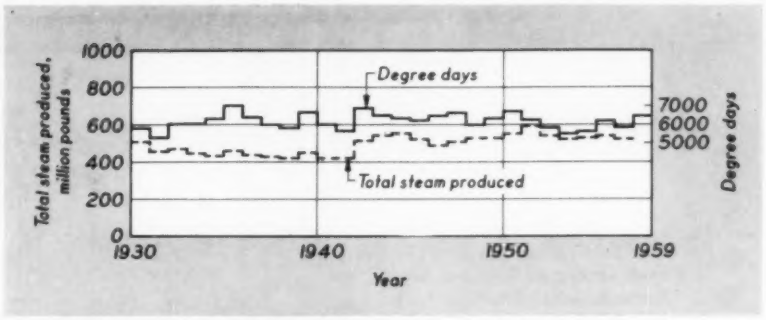
In 1950 a 200 ton steam jet was installed in a laboratory. Using steam at 65 psig and a large evaporative cooler on the roof, this unit has bogged down on muggy days and has used excessive steam and water. It is hard to control and maintenance has been heavy.

More recently, two steam units (one 200 ton and one 150 ton) have been installed in hospitals. Use of steam at 25 psig has lowered steam consumption, created less noise, and required less attendance, although use on light loads has required that inlet air be preheated at times.

The great advantage of the type using steam at 25 psig or less to the heating plant operation rests upon a future change in policy, namely the requirement to charge full unit price for steam, whereas the fuel-cost-only basis would make a very good case for more summer cooling. Laboratories, lecture halls and dining halls, at least, could all be cooled in summer at such low costs.

Rising Costs Are Challenging

The increase in cubage heated from 50 million cu ft in 1929 to 68 million cu ft in 1959, the great increase in fuel cost, and costs for wages and supplies have been a great challenge to operate efficiently, and to pay in each year's budget as interest on the investment and for depreciation of physical facilities used for the steam service.



2 ANNUAL STEAM PRODUCED has remained relatively constant over 30-year period despite large increases in volume of heated space

Interest on the new money exclusive of land is charged at a rate favorable to the endowment funds used, a part of the fixed cost.

Depreciation is charged to replace the physical facilities, charging as accurately as possible for wear and tear. This began as a charge on the construction cost, using standards, including the life for each part generally used in profit operations. Increased replacement costs have required several revisions in the depreciation schedule to assure reserves for replacement in invested funds.

The replacement fund was started by setting aside $20,000 in the partial first year, $28,000 the next year, and $32,154 each succeeding year based upon an inventory or cost of $1,342,183 for the heating plant and $816,105 for the underground system, or $2,158,288 for both.

This annual amount was finally increased to $62,433 in 1957-58, based on increased replacement costs to $2,663,800 for the heating plant and $1,633,000 for the underground steam piping system, or $4,296,800 for both. The ratio, it may be noted, is a much smaller percentage than other costs, especially in comparing the unit coal cost ratio of increase for this period. This reserve fund has been invested and earns at about the same rate as endowment funds.

The interest charged each year for funds used in construction has returned to the university a rate equal to other funds which require management and other expense. Here, only a book transfer is required for this purpose.

Other services, including the underground electric power lines from the heating plant to the many buildings, are treated in like manner. Since 1930, no electricity has been generated, but the high tension distribution system is ready if it should be found advantageous.

Reserve Fund Has Grown

Meanwhile, the reserve for depreciation has accumulated. The replacement fund, including interest, reached almost $700,000 in 1949, before expensive replacement of equipment or large repairs were necessary. In the years since 1949, loans for short terms have been made from replacement funds to expand plant facilities of auxiliary operations of the university — a practice which might well be recommended to others.

The unit cost in billing has been as follows, measured in cost (cents) per 1000 lb of steam at the point of service:

Year	Estimated	Actual
1930-43	90.0	85.3
1944	95.0	92.6
1945	95.0	92.6
1946	110.0	92.6
1947	120.0	92.6
1948	121.0	92.6
1949	131.0	113.9
1953	130.0	141.6
1954	130.0	129.0
1955	132.0	125.0
1956	141.0	142.0
1957	146.0	143.3
1958-59	...	138.0

The use of factor "X" as an index is shown by Fig. 2. The average for each year is shown by this chart. During the years it has been used, almost from the beginning of this operation, it has been relied upon to gage the excessive use or waste of

steam and to indicate where the trouble can be found in the system.

Piping Maintenance Low

Troubles due to interior corrosion of steam main and return piping have almost disappeared. With only 10 percent makeup, water treatment is not serious. A chemical is introduced into the boilers in very small quantities for finishing. Continuous blowdown has been effective.

Water is tested at many stop cocks, around return line connections at tanks, radiators, etc., and a nearly constant neutral point of hydrogen-ion concentration is maintained. It has been found, also, that steel pipe has been greatly improved, and that wrought iron pipe would not be worth the cost premium for our type of service.

As mentioned last month, connecting steam piping between the boilers and the buildings is run in walk-through tunnels below ground. Main distribution lines, which run 6600 ft, were installed in two parts. The first part gave trouble at the expansion joints. The second, built a year later, had improved joints. The piping gave trouble at the welds, showing up as leaks in the older section. Split welding sleeves were welded over these joints in 1942.

These mains convey 170 psig steam (150 F superheat at the plant) controlled by desuperheaters added many years after the plant was built. Steam is reduced at junctions to 75 psig and at fan rooms to 5 psig. No other troubles have been experienced, but in the long range program to replace old piping, some of which has been in continuous use since 1901, anchorages have been strengthened or added at junctions.

Distribute Steam Many Ways

Many types of distribution structures are in use, including old brick arches on steel or iron beams on which campus walks are laid, pipe conduit, and poured insulation (for small lines). A section of an old branch steam main encased in wood log conduit was replaced in 1954.

Extensive replacement and rearrangement of pipe sizes over the years has greatly reduced line losses. Here again, adequate provision for expansion, good anchorage, and good insulation have cut maintenance costs.

Reduce Peak Loads

Load dispatching in the months of heavy heating has been interesting. As the plant grew, steam was permitted to enter the piping at the tunnel to keep up the pressure. Peak loads had early attention. As the load curves have shown, the heating plant uses its steam capability only about one-third of the time, but still must be sized to carry the peak load when necessary. Once designed, the boilers must be used as a team. "Peak reduction" offers many economics inside the boiler room.

It was soon found that two building engineers, each in charge of a group of buildings, or of one large building, could preheat parts or all of his volume and in so doing reduce the magnitude of the later peak load. It was not long before the needle-sharp peak of the daily winter load, which occurs early in the morning, could be suppressed; that is, it could be pushed down in volume by spreading out the time. Before long, the maximum hourly steam delivered to the tunnel mains by the boilers was very much reduced. This practice has continued.

The cost for the small added amounts of steam used for the extra time was more than saved in the simpler boiler scheduling. On some days, it meant that one less boiler was needed.

30 Years In Retrospect

Perhaps the struggle with the old (1901) central plant — with its old d-c electrical machinery, years of overload, and little money — fixed a determination to build for the long future, for good service, and at lowest cost. The added cost to locate the 1929 plant at the railroad was large. But it has long since been paid off.

The delay in decision from 1921 to 1927, when the old plant had to have expensive new boilers, stacks, etc., to meet a great expansion was at times grievous to bear. But the studies that went into this then new plant brought decisions of the greatest importance.

The site chosen was one of four studied and cost much more because of the distance to the track site. As studies went on, the boiler unit size grew from 500 hp at 200 percent rating to 1200 hp at 300 percent rating. After the plant was completed with three boilers, the fourth boiler (then not needed) was installed for the future and the decision was made to meter and bill and to provide adequately for replacement funds through proper depreciation charges.

No report of burning about 1 million tons of coal should conclude without an attempt to appreciate the men who have done so many fine things. In 30 years many men come, do the task, and go. So our roster is long. The plant has been, in the best sense, the "glory hole" for many dedicated men. It has also been a training school from which many have graduated to much more important work — a few to striking success. Openings in larger organizations plus our training have thereby produced more engineers. ⊣

References

[1]*Reliable Steam Consumption Records Mean Better Heating at Minimum Cost*, by Lyman R. Flook. Heating, Piping & Air Conditioning, June 1936.

[2]*Persistent Conservation Efforts Cut Steam Consumption in Half*, by Lyman R. Flook. Heating, Piping & Air Conditioning, November 1935.

[3]*U. of C. Air Conditions New Building*, by Lyman R. Flook. Heating, Piping & Air Conditioning, July 1938.

tricks and trends

LESTER T. AVERY, author of this feature, is president of Avery Engineering Co., Cleveland mechanical contractor, and a member of Heating, Piping & Air Conditioning's board of consulting and contributing editors. On this page, he reflects on his installation experiences.

Evaporative Condensers Guilty, Too

LAST MONTH we discussed some of the problems caused by water cooled condensers which show up as compressor difficulties or failures. This month we direct our attention to the difficulties with compressors directly attributable to evaporative condenser operation.

When we first started to use evaporative condensers there was discussion with manufacturers' engineers as to how to keep pressure constant. One way was used whereby the circulating water pump was cycled on pressure control. Another was to cycle the fan on pressure control.

We quickly discovered that cycling the pump was no good. The pressure dropped too rapidly due to evaporative cooling and mud and dirt deposited on the fin coils. As this residue built up, it gradually stopped up the air circulation. Having decided that the water pump had to run continuously to flush the dirt off of the coils and keep them completely wet, we then began to cycle the fan.

We ran into a strange problem on some jobs: When the fan control was set, for example, to turn *on* at 130 psi and *off* at 115 psi, the 15 psi pressure drop caused the liquid line to boil. This release of pressure caused very erratic expansion valve operation. With a machine operating on pressure unloading, the discharge pressure dropped faster than the expansion valve could compensate. As a result, the machine unloaded due to the drop in suction pressure.

The outcome was that the machine was operating intermittently unloaded at times when full capacity was needed. Full capacity was impossible because the unloaders couldn't be kept from unloading. Expansion coil performance was poor and the job gave no end of trouble.

On the other hand, similar installations seemed to give no trouble at all. It was a great mystery as to why this trouble occurred on certain jobs (which had no reference to size) and not on others. The only cure on the problem installations was to run the fan continuously down to a pressure as low as 75 psi. This cleared up the situation, kept the refrigerant in the liquid line, let the expansion valve control the superheat, kept the discharge pressure constant, and kept the unloaders out of the circuit. Everything worked fine at all pressures as long as they were constant.

Unfortunately, every time a new man went on the job, he set the unloaders to unload at the regular pressures and then set the fan to cycle. The fat was in the fire: It might require several valve burnups, cracked valve plates, and broken unloaders before it was discovered that our man, in his enthusiasm for efficient operation, was cycling the fan.

Here again, it is obvious that the condenser was the cause of the compressor's troubles. The condenser is still in the same shape it was when purchased 10 years ago, but we've had to replace compressors, valve plates, valve heads, and unloaders.

While on this subject, we have observed the same problem with fluctuating temperatures in a cooling tower. When the tower fan cycles, the water temperature changes only 2 or 3 F. But this is enough to affect the condensing pressure on the water cooled condenser. This change in the condensing pressure with the changing tower water temperature caused unloaders to operate and gave us an unloaded condition when we did not want it. The cure here was to run the water temperatures much higher in the tower. Instead of cycling at 70 to 72 F, we did so at 80 F. By keeping the head pressure up with the higher water temperature, we got rid of the boiling of the liquid line.

An evaporative condenser using well water for makeup experienced still another problem: calcium had deposited on the fins to the extent that the air circulation was stopped up in less than a month. It was necessary to use water treatment and continually flush off the the solids as they developed. In dirty atmospheres we've had leaves and debris foul up the fins. A number of manufacturers have stopped using fins on evaporative condensers for this reason.

Algae and slime are separate and distinct organic problems requiring water treatment. Scale and mud require different treatment so that the user of the evaporative condenser must watch the operating conditions and use the treatment required for these external contaminants. The high wet bulb temperatures and the overload on compressors that occurred last summer showed up many weaknesses in evaporative condenser operation that did not appear in cooler weather and lighter loads.

Here again, preventive maintenance is of the essence. Anyone with evaporative condenser applications is advised to thoroughly clean and check all equipment to make sure it is in top operating condition before warm weather starts. ∓

Pipe Welding Terms Defined

BY HELMUT THIELSCH
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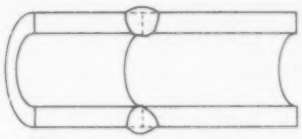
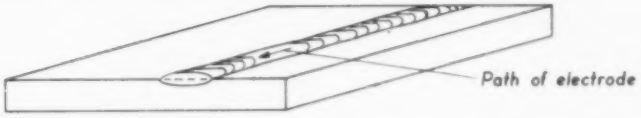
This is a continuation of a listing of pipe welding terms and their definitions. Earlier listings appeared in the November and December 1958 and October 1959 Data Sheets.

Square groove weld: A type of groove weld. Square groove welds are generally used on piping and tubing of wall thicknesses up to ⅛ in.

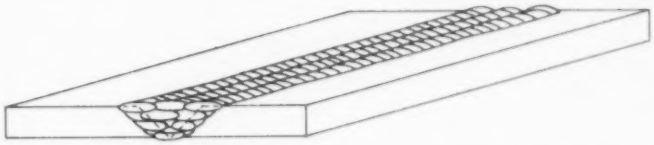


Stress relief heat treatment (stress relieving): Uniform heating of a structure or portion thereof to a sufficient temperature, below the critical range, to relieve the major portion of the residual stresses. Stress relieving is employed to relieve stresses induced by welding, cold or hot bending or forming, normalizing, etc. Chrome-moly alloy steel piping is usually stress relieved at temperatures between 1300 and 1400 F for one hr per in. of wall thickness, with 1 hr as the minimum.

String bead: A type of weld bead made without appreciable transverse oscillation.



String beading: The deposition of string beads. String beading is extensively used in the welding of austenitic stainless steel materials.

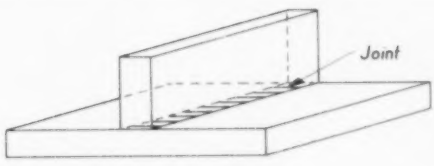


Submerged-arc welding: An arc welding process wherein coalescence is produced by heating with an electric arc or arcs between a bare metal electrode or electrodes and the work. The welding is shielded by a blanket of granular fusible material on the work. Filler metal is obtained from the electrode and sometimes from a supplementary welding rod.

Swaging: Reducing the ends of pipe and tube sections with rotating dies which are pressed intermittently against the pipe or tube end.

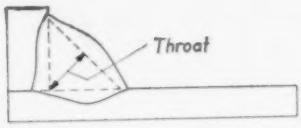
Tack weld: A weld made to hold parts of a weldment in proper alignment until the final welds are made.

Tee joint: A joint between two members located approximately at right angles to each other in the form of a "T."

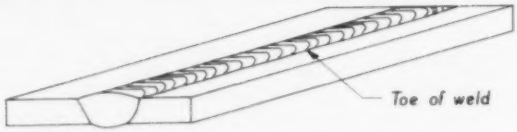


Tempering: A process of heating a normalized or quench-hardened steel to a temperature below the transformation range, and from there cooling at any rate desired. This operation is also frequently called stress relieving or drawing.

Throat of a fillet weld: The distance from the beginning of the root of the joint perpendicular to the hypotenuse of the largest right triangle that can be inscribed within the fillet weld cross-section.



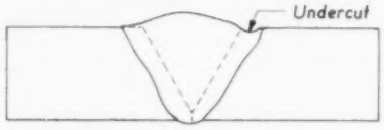
Toe of weld: The junction between the face of a weld and the base metal.



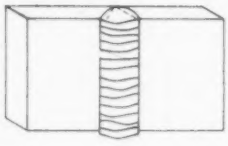
Tungsten electrode: A nonfiller-metal electrode, used in inert-gas arc welding, consisting of a tungsten wire.

Underbead crack: A crack in the heat affected zone not extending to the surface of the base metal.

Undercut: A groove melted into the base metal adjacent to the toe of a weld and left unfilled by weld metal.

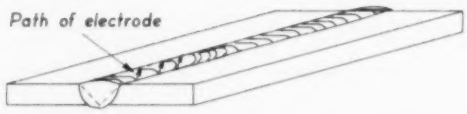


Vertical position: The position of welding wherein the axis of the weld is approximately vertical.



Vertical position: Pipe welding—The position of a pipe joint wherein welding is performed in the horizontal position and the pipe may or may not be rotated.

Weave bead: A type of weld bead made with oscillation of the electrode transverse to the direction of travel.



Weldability: The capacity of a metal to be welded under the fabrication conditions imposed into a specific, suitably designed structure and to perform satisfactorily in the intended service.

Weld bead: A weld deposit resulting from a pass.

More pipe welding terms will be defined and illustrated in early issues.

"Cut Shopping Center Cooling Costs Through Central Air Conditioning"

Designer of Southdale job voices advantages at ARI show

"INITIAL COSTS, operating expenses, and maintenance charges in shopping centers can be greatly reduced if their developers would install central air conditioning systems instead of requiring each tenant to provide his own individual system," said Herman Guttman, a partner in Victor Gruen Associates, architects and engineers, speaking before the 11th biennial exposition of the Air-Conditioning and Refrigeration Institute held recently in Atlantic City.

To prove his point, Mr. Guttman cited the Southdale shopping center* in suburban Minneapolis. This is an 800,000 sq ft multi-level structure with two department stores, 70 other shops, and gracious walking and sitting areas—all entirely enclosed and air conditioned. It is the world's first such installation.

Mr. Guttman said that, despite the extremes of temperature prevailing in Minnesota, heating and cooling costs are lower than those of any comparable shopping center.

"Only a few years ago it was commonplace to find signs on the doors and windows of commercial establishments proudly announcing that they were 'air conditioned' or '20 degrees cooler inside,'" stated Mr. Guttman. "I suspect that the store owner was more interested in the announcement than in performance.

"He had a right to be proud, for this represented quite an investment on his part. At his own expense he installed the equipment, provided necessary ductwork and structural changes, increased electrical service, and paid for all operation and maintenance.

"This pattern in the commercial retail field has prevailed right up to the present time, and since rentals are geared to established real estate practices, the investment by the tenant follows this historic trend.

"Even in present-day regional shopping centers, which are conceived as integrated, planned entities, the developer too often tells the tenant to put in his own air conditioning. Despite all logic, engineering considerations, and economies of both capital investment and operating cost, this 'do it yourself' philosophy prevails. The reasons:

"1) No space is required for central plant equipment, and the tenant is expected to put his equipment in the valuable space he rented or possibly on the roof.

"2) No financing is required to cover the equipment cost.

"3) No operating personnel is required. In fact, the developer has no operating cost which he, in turn, must recover from the tenants.

"4) Leasing is simplified because rent negotiations are not complicated by discussions of standby charges, dry bulb and wet bulb temperatures, diversity factors, and all the other details that neither the leasing agent nor the tenant can comprehend.

"5) No complaints about the air conditioning are voiced because they fall on deaf ears. As long as differences in the human metabolism exist, and until we develop a cooling system for the human body rather than the space he occupies, there will be criticism of air conditioning; but our wise developer, who had nothing to do with the installation, need only smile and act sympathetic.

"Now — although our happy developer is quite content with this state of affairs, his architect is *not*. The beautifully designed edifice begins to sprout equipment on the roof. Even if an adequate screening job is done, it is costly and the roof must be designed to carry the equipment loads.

Concept Is Grossly Inefficient

"The most disturbing aspect, however, is the gross inefficiency of the entire concept. It can readily be demonstrated that the central plant is far more economical both in first cost and operating cost. Fractional tonnage increments, diversity factors, lower electrical rates through single metering, standardization of filters, spare parts, and organized maintenance programs all contribute to the overall savings. We hate to see money wasted and every dollar that is needlessly spent may well force the elimination of some visual amenity that contributes to the success of the project.

"These are not technical problems but administrative considerations, and our job is to provide an efficient air conditioning facility within the prevailing leasing pattern and attempt to eliminate the developer's problems.

Southdale Job Is Proof

"To some degree this has been accomplished in the design of the Southdale shopping center. Because the Minnesota climate leaves something to be desired, shopping-wise, it was decided to create an artificial environment that would, in effect, be a 'perpetual Spring.'

"Two levels of stores are grouped around a block-long garden court 50 ft high, and all storage and deliveries are located in the basement. This resulted in a highly compact building arrangement with a mini-

*Details of the Southdale installation were covered in the article, *600 Ton Heat Pump System Creates "Eternal Spring" in Shopping Center*, which appeared in the January 1957 issue.

mum of external exposure. It became apparent that even in −20 F weather, the internal gain of lighting and occupants would require cooling. The trick then was to transfer the internal heat generated by lights and people to the perimeter of the building to offset the heat loss through exterior walls and roof. A highly economical system has resulted. Southdale has the lowest operating cost for heating and cooling of any comparable shopping center.

"The availability of 50 F well water, and facilities for disposition of water; the availability of natural gas at competitive rates; and other engineering considerations influenced the decision to install the largest commercial heat pump in the U.S., in combination with packaged air conditioning units in tenant sales areas.

"The water flow cycles are completely interlocked and, by an arrangement of heat exchangers and flow control, exceptionally high efficiency is obtained. The water used for cooling the natural gas engines which drive the compressors is circulated through a closed system. The cooling water is first circulated through a coil in the crankcase of the engine jacket where it picks up the heat of combustion and friction. From the engine jacket it is circulated through an exhaust gas heat exchanger where it is further heated by removing a large portion of the exhaust gas heat. This hot water is then circulated through one of the water-to-water heat exchangers where it loses its heat to the condensing water returning from the tenant package units.

"One of the heat exchangers supplies domestic water for the entire center. Another furnishes hot water for the perimeter heating system. A third exchanger heats a glycol solution for the coils of the snow melting system under the truck ramps.

"During the summer the excess hot condensing water is pumped out on the roof or diverted to a glacial drift storage well. This 120 F water, which cools down to some 80 F, is then pumped out during the winter months to preheat the ventilation air for the entire center. This is introduced at the roof of the garden court. From this giant plenum, air for ventilation enters each of the tenant spaces by means of outlets located on the store fronts and is exhausted at the rear of the tenant space into the service corridor. This air is then circulated through the basement areas, providing secondary cooling, and ultimately into the truck tunnel where, together with the automotive gases, it is exhausted to the atmosphere.

Couldn't "Do It Yourself"

"With the 'do it yourself' technique, the Southdale system could not have been accomplished, and each of the components described would have been completely self-contained without the economic benefits. One system would be generating hot water while another was wasting it.

"The potential benefits justified a selling job and it was no easy task to convince the developer, the tenants, the leasing men, the building superintendents, and municipal authorities, to name but a few. We attacked the developer's arguments:

"1) Penthouse space at relatively low cost was available on the roof for the equipment. This compact location for all fans and compressors reduced the runs of piping and wiring and eliminated all major ductwork with a corresponding reduction in the cubage of building.

"2) Financing of the installation was accomplished by a system of "standby charges" to tenants, over and above rents, in order to amortize the central plant equipment. The lending institutions, once they were convinced, were willing to capitalize these charges just as they did rent in determining the amount of the loan.

"3) Careful selection of superior equipment and an elaborate automatic control system has resulted in a minimum of operating personnel and operating cost. In order to eliminate complicated metering, a formula (palatable to tenants) was devised establishing tentative monthly charges for the operation to be adjusted at the end of the year on the basis of actual performance. Tentative charges were predetermined, based on hours of operation, size of store, vacancy factors, etc., and were well within the limits of past performance records. At the end of the first year's operation a refund to tenants was made.

"4) Leasing was difficult but not insurmountable. The debate is by no means ended, for there have been some sad experiences with central plant installations in other centers. With the success of Southdale, however, we feel assured that the next one will be much easier.

"5) Complaints have been relatively few. After the shakedown period they were almost non-existent. We strongly suspect that the major reason for this situation is the superior standard achieved by the well-engineered central plant as compared with the often lower standard installations acceptable to tenants when left to their own devices.

Determine Tenant Charges

"In spite of these achievements, the design of mechanical systems for shopping centers is still far too complicated. Provisions must be built in for those stores which operate when the rest of the center is closed. There are times when the mall is occupied and the stores are not. Merchandising promotions and special events require elaborate flexibility.

"Within all this activity, costs must be carefully segregated so that the individual tenants are never charged for more than their equitable share. And to reach even this point, these concepts must be spelled out in a lease acceptable to both parties.

"We keep hoping that the entire situation will be simplified and heating and air conditioning will be included as part of rent, as is now done in office buildings and apartment houses. However, as long as shopping centers contain mixed occupancies and the tenants remain on guard for any situation involving inequities in charges or inefficient operation, and lending agencies are reluctant to finance developers who lack a history of operating experience, we must work within this pattern and keep on our toes. Perhaps this is as it should be," Mr. Guttman concluded.

the law and your profits

JOHN F. MORRISSEY, author of this regular feature, is an attorney at law and has an extensive practical business and legal background. This series is based on actual cases. All names are, however, fictitious. It should, of course, be remembered that the law varies in different states.

Owner's Failure to Prove Negligence Saves Contractor in Warranty Case

GENERALLY, there is a warranty implied in a sales contract that equipment sold will reasonably serve the purpose for which it was designed and purchased. There are, of course, often express warranties spelled out in the contract itself. The following case illustrates a practical aspect of warranties.

Les Boyle decided that his apartment building needed a new heating system and contracted with the Steady Flow Heating Co. The contract provided that Steady Flow would install a complete heating plant, together with all necessary controls. The contract also provided that "all material and labor are guaranteed to be in good workmanlike manner."

The system was installed in April and the following December the boiler cracked and became inoperative.

Les Boyle brought suit against Steady Flow on the contract, alleging that both the express and implied warranties of quality had been breached.

Boyle argued that the mere fact that the plant had operated without difficulty for approximately 10 months was no indication of good workmanship or quality:

"After all," stated Boyle, "April through November are relatively mild months compared with the severe cold months of December, January, and February. During the summer months the system was shut down most of the time. As soon as it was put to a real test in December, it burned out."

Steady Flow contended that it was Boyle's burden to prove negligence on the part of the company:

"The heating system was in the sole care and custody of Boyle," stated Steady Flow, "and the assumption must be that Boyle was negligent in taking care of it since he has offered no proof that our material or workmanship was defective."

In hearing the evidence of both sides, the court found that the boiler operated efficiently until December 28. It also learned that the boiler was equipped with low-water cutout, which was attached to a transparent glass gage. The cutoff consisted of a float connected with a mercury switch. When the water in the boiler reached a low point, the mercury switch cut off the electrical power, stopping the flow of fuel.

In the event the float was obstructed, the stoker would continue to operate. The amount of water in the boiler was shown at all times on the glass gage. Shortly after the installation of the heating plant, the operation and function of the low-water cutoff was explained to the plaintiff.

Steady Flow offered evidence—disputed by Boyle—that someone had inserted a piece of cardboard into the low-water cutoff, thus preventing it from functioning properly and causing the boiler to become overheated.

Boyle in turn maintained that the cutoff valve had never functioned properly.

After considering both the disputed and undisputed evidence, the court held that it is an established rule of law that the burden of proof is on the person alleging the breach to establish the warranty and the breach of it.

"Aside from the fact that the boiler cracked," said the court, "there was no proof offered by Boyle tending to show that the cracking of the boiler was due to any breach of warranty on the part of the defendant. Moreover, there was some evidence that Boyle may have been negligent since a piece of cardboard had been inserted into the low-water cutoff."

"The heating plant operated continuously and efficiently for almost 10 months and there was no evidence of faulty installation," stated the court. "Under these circumstances and the absence of proof by the plaintiff showing that the defendant was negligent, the plaintiff cannot recover."

It should be pointed out that courts have sometimes demonstrated a greater tendency to find a breach of warranty than the court did in this case. ∓

Piping Design for New Ice Rink Permits Dual-Use of Concrete Slab

Skaters' wintertime mecca, which freezes 2 in. of water in outdoor temperatures up to 50 F, doubles as stadium parking lot for 200 cars during baseball and football seasons

BY WILLIAM J. O'MAHONY
Peter Carver Associates
Consulting Engineers

THE DESIGN and installation of piping for an outdoor ice skating rink that also serves as a parking area made the Baltimore Municipal Rink one of the most interesting problems our firm has encountered. The rink, which is the standard ice hockey size of 85 × 185 ft, is a part of the parking area of the city's Memorial Stadium, home of baseball's Orioles and pro football's champion Colts.

Used for skating between the end of the football season in December and the opening of the baseball season in the spring, the rink is about 150 ft from the stadium where the two 75 ton refrigeration compressors, with their 100 hp motors, and the condensers are located. These requirements made the design of the piping system different from the customary or conventional ice rink piping systems because of the distance required to deliver the brine solution to the rink piping system. Also a part of the problem was the weight load imposed by 200 automobiles when the slab is used for parking.

Design requirements demanded a piping system that would provide a surface temperature for freezing water at outdoor dry bulb temperatures up to 50 F and at a wet bulb temperature of 65 F. To accomplish this condition, it has been found through our experience that calcium chloride brine at about 15 F circulated through 1¼ in. diameter steel pipe on 4 in. centers provides the desired results.

These design conditions preclude the possibility of any unevenness in the thickness of the ice above and between the pipes with a flow rate of 9.66 gpm per ton of refrigeration capacity. For this rink, with a ton-

RINK PIPING was placed on steel wire cradles, or "chairs," prior to pouring of slab. Concrete then flows completely around pipe without breaking continuity of slab

PIPES are being welded to header (foreground) while work crew carries full length of pipe for placement

nage capacity of 150, the total flow rate is 1350 gpm.

Calcium chloride brine is used because a solution is needed with a freezing point low enough to allow ice to be made using a cooling range of 17 to 14 F. This range limited the choice to either calcium chloride or a glycol type of brine. The first cost of calcium chloride is less, as are its viscosity and density. Consequently, less pump horsepower is required. Too, glycol brine may require a larger cooler than calcium chloride because of its heat transfer characteristics.

It is felt that with proper venting and an air-free system, together with proper pH control and maintenance, corrosion will be negligible with calcium chloride brine in the steel piping system.

Through the years ice rink piping systems have been made up of 1 in. pipe on 3½ in. and 4 in. centers and of 1¼ in. pipes on either 4 or 4½ in. centers, depending on whether it is an indoor or outdoor rink, has sand fill or a concrete floor, availability of welders, cost of pipe, and other such factors.

For concrete slabs we have standardized on 1¼ in. pipe on 4 in. centers with the headers running the short dimensions of the rink. This affords the advantages during construction of fewer sleeves through the header trench and greater distance between pipes for pouring the concrete, and permits the insertion of sleeves for dasherboard and protective fence supports. In this rink a total of 54,000 ft of 1¼ in. steel pipe is embedded in a 6 in. concrete slab.

Wire Cradles Aid in Levelling

Steel wire chairs were used to support the rink piping which permitted the piping to be levelled within ⅛ in. by using shims. This type of wire cradle is very effective since it lets the concrete flow completely around the pipe without breaking the continuity of the concrete slab (which would lead to less cohesion of the steel and concrete). The thickness above the pipe is 1¼ in.

Outline Installation Steps

Before any pipe welding was done, the cradles were located and the 40 ft double random lengths of pipe were laid in place. Then, the 1¼ in. oxyacetylene welds were made on the site to make up each 185 ft run. Next, each run was slid through the header trench sleeve and welded to the headers. The last step was to weld the return bends on at the opposite end of the rink, thus forming the 370 ft hairpin.

The header trench houses the three-pipe, balanced-flow, reverse-return header system which distributes the brine to the rink floor. This is basically the same principle used in heating systems to obtain balanced flow through various heating units. With this system, valves are not necessary on each hairpin bend.

To circulate the brine, two close-coupled 50 hp pumps are provided, each with a capacity of 1350 gpm at a head of 95 ft. One pump runs continuously while the other serves as a spare.

The 8 in. and 6 in. headers were shop welded by the electric arc method, with 1¼ in. spuds provided every 8 in. on centers to be field welded to the hairpin bends. Of course, extreme care had to be taken in the welding of the header to keep all spuds straight and true.

The brine and rink piping was tested first with air and then hydrostatically at 80 psi before the concrete was poured.

The concrete used in the rink floor has a strength of 4000 psi with a water-cement ratio of 5 to 6 gal per 100 lb sack, and a course aggregate of ⅜ in. As an added precaution, the stadium agreed to keep all cars and buses from parking on the rink section for one year after pouring.

A thermostat located in the brine return from the rink automatically controls the refrigeration compressors through a step controller which allows four steps of capacity control since each compressor can be unloaded 50 percent. Normally, one compressor can carry the load, but when ice is being made, both compressors are required. Safety controls include high and low refrigerant pressure switches, compressor oil failure pressure switches, a low brine temperature cutout, and a brine pressure failure cutout.

The assistance and cooperation provided by Douglas S. Tawney, stadium manager, Baltimore Municipal Rink, in the preparation of this article is gratefully acknowledged. ∓

Heat, Ventilate New High School Campus Many Different Ways

- ***Unit heaters, radiant baseboard in dining hall***
- ***Air handling units in science block***
- ***Forced warm air system in auditorium***
- ***Unit heaters, exhaust fans in gym***
- ***Conventional radiation in dorms***

. . . for about $2.30 per sq ft

• Four centrally located oil fired package boilers, each rated at 2 million Btu per hr, will generate 200 F hot water to be conveyed through underground mains to heat all buildings in this 1200 × 500 ft high school campus in England. Faced with the problems of a limited budget, a close deadline for design completion, and a limited amount of space for equipment, the architect-engineers designed heating and ventilating systems to fit the needs of each individual building. As a result, the campus is heated in a variety of ways, all using centrally supplied hot water as the heating medium.

Mr. Koerner is a mechanical engineer with 10 years' experience in design and construction of heating, ventilating, and air conditioning systems. Gaining his early experience with the architect-engineering firm of Holabird & Root and at the U. S. Atomic Energy Commission plant in Paducah, Ky., the majority of his work has been done in Italy, France, and England. Mr. Koerner worked in Rome for ARAMCO on the design of facilities in Saudi Arabia for two years. For the past three and one-half years he has been employed as a mechanical engineer for the planning and design of U.S. Air Force facilities in the United Kingdom.

BY WILLIAM B. KOERNER
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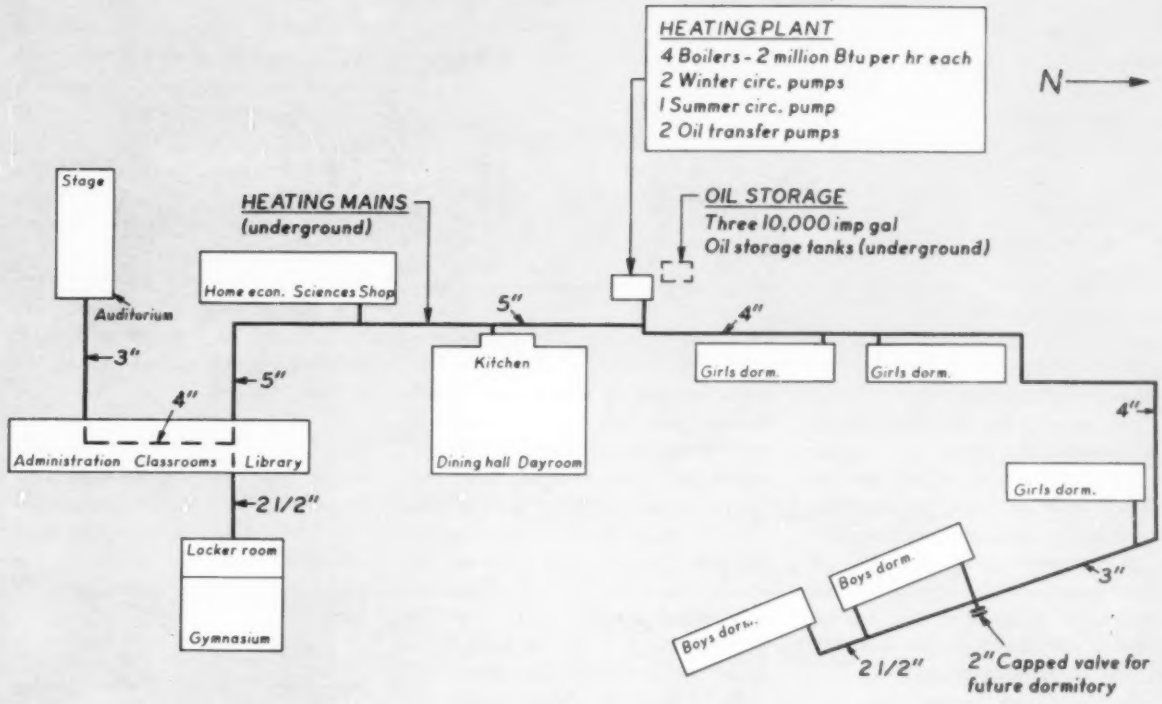
Architect-Engineer Joint Venture

IN PLANNING and designing the heating systems for the first American high school to be built in England for U. S. Air Force dependents, the following requirements had to be met:

1) A limited budget
2) A deadline for design completion
3) A limited space for mechanical equipment in each building, without sacrificing functional requirements.

Because the buildings for this campus, now under construction, will cover a broad area of 1200 × 500 ft, it was decided to use a central boiler plant with four oil fired package type steel hot water boilers, each rated at 2 million Btu per hr.

Hot water will be distributed to the various buildings through mains installed in concrete pipe which are



SPRAWLING HIGH SCHOOL CAMPUS will be heated by 200 F hot water distributed via underground connecting mains (sizes indicated above) installed in concrete pipe

provided with removable precast concrete covers for inspection. Where possible, the heating mains are installed under sidewalks, so that snow will be melted from these areas.

The hot water leaves the boilers at 220 F and at a pressure of 50 psig. Piping mains are pressurized by nitrogen to maintain the supply temperature at 220 F.

The campus will consist of a dining hall and day room; a two-story academic block, with administration offices, classrooms, and library; a science block, with woodworking and machine shops, laboratories for physics, biology, chemistry, and home economics; an auditorium; a gymnasium; three 2-story girls' dormitories; and two 2-story boys' dormitories with provision for one future dormitory.

The inside design temperature for all buildings is 70 F, except the gymnasium which is 60 F. (The outside design temperature for this area in England is 25 F.) With the exception of the dormitories, all buildings must be well ventilated. Comfort air conditioning is not really required.

The types of heating systems being installed for the various buildings and the reasoning behind their selection are as follows:

- **Dining hall:**

This building, almost entirely glass, has a ceiling height of 15 ft and a window sill height of 2 ft. Early in the design stage it was determined that sufficient hot water radiant baseboard heating elements could not be installed under the sill due to space limitations and ventilation requirements. It was therefore decided to use a suspended ceiling to house unit heaters and exhaust fans. Baseboard heating was then designed to provide background heating only. All piping and heating elements are economically concealed under the sill.

The unit heaters can be adjusted to provide 100 percent outdoor air, a variable quantity of outdoor air, or an outdoor air supply with or without a fixed minimum.

Exhaust air is taken out through mechanical exhaust hoods in the kitchen area when it is in use. As the day room lounge section is used during the evening for recreation, a mechanical exhaust system is also provided which can be adjusted to remove up to 100 percent of the air in the system when the kitchen exhaust hoods are not operating.

- **Academic block:**

This two-story building houses classrooms, offices, and a library. The only available space for ventilation ducts is in the corridors. Because of space limitations, it was not possible to include a mechanical equipment room for heating and ventilating units of the size required.

Therefore, it was decided that four exhaust systems, each equipped with two-speed fans and using ducts in the corridor above a suspended ceiling, would provide the desired ventilation in winter and summer. During winter operation, the fans are operated on low speed and no makeup air is in-

troduced except by natural infiltration.

Heating is supplied by baseboard extended surface natural convection heating elements with unit ventilators used for the toilet areas only.

● Science block:

Two heating and ventilating units with connected ducts will serve this structure. Two units are needed due to the large difference in air requirements of the building.

One unit handles the woodworking and machine shops only. Air requirements for these areas will be extremely high and must be controlled individually because of the intermittently operated exhaust system. All other areas will be served by the other unit. No air is recirculated because of the chemicals that are used in some of the laboratories.

The combined heating and ventilating systems were designed to provide flexibility for winter heating and ventilating and summer ventilation. The hot water piping for this building was designed on the reverse return principle.

● Auditorium:

This building will be used for various activities such as theatrical productions, movies, and other school functions. Because of the varied ventilation requirements, the system had to be designed for recirculating air with a varied amount of outdoor air and a positive exhaust during the winter. For summer, it will be necessary to admit all outdoor air with positive exhaust.

TABLE 1 — TOTAL ESTIMATED COST for heating and ventilating systems was about $2.30 per sq ft. Cost breakdown per building for these systems is as follows

Dining hall	$ 22,000
Academic block	36,200
Science block	23,300
Auditorium	25,200
Gymnasium	18,400
Dormitories	83,800
Boiler plant and heating mains	135,000
Total	$343,900

A forced warm air heating and ventilating system with supply air ducts installed up high so as to admit the air just below the ceiling will meet these requirements. Return air intakes are installed in the floor, and the air is returned to the heating coils through concrete pipes embedded in the slab. The method of returning the air for recirculation was selected to ease volume control and to keep this system away from the mechanical exhaust system with its duct system installed high in the auditorium.

All air intakes and supply outlets are equipped with manually adjustable volume control dampers. Radiators are used in the dressing rooms, scenery shop, classrooms, and toilets.

● Gymnasium:

There was no problem in determining the type of system for this building. The architecture of the building more or less limited the system to high level unit heaters and exhaust fans in the gymnasium area.

Because no movable windows are used in any other area in the building (locker rooms, offices, and toilet rooms), the structure must be well ventilated mechanically. The type of system chosen had to fit in the available space. Therefore, a combination of high level unit heaters with outdoor air connections and mechanical exhaust fans is used in the gymnasium area only.

In other areas, baseboard extended surface heating elements are used, together with unit ventilators which admit tempered outdoor air. A mechanical exhaust system is also used. The unit heaters and unit ventilators can be adjusted to provide a variable quantity of outdoor air up to 100 percent.

Dormitories are all heated by conventional radiation. The only special consideration was for the third boys' dormitory which will be built in the future. For this, a 2 in. capped valve was installed in the 3 in. main so that adequate heating capacity can be connected later.

Minimize Size of Boiler House

The four steel boilers are three-pass internal furnace horizontal fire-tube package type. The front part of the boiler plant building was designed with removable panels for tube withdrawal. This was done to minimize the boiler house area.

Oil storage consists of three 10,000 imperial gal underground tanks. Two oil circulating pumps permit one to be used as a standby. Three hot water circulating pumps are used in this plant: two for winter operation (with one as a standby) and one to handle the domestic hot water load only in summer. The hot water standby pump for winter operation and the standby oil circulating pump will guard against shutdown of any of the systems for maintenance. ∓

AGA Eyes $34 Billion Building Boom

CONSTRUCTION programs costing an estimated $34.4 billion will nearly triple the value of the gas utility and pipeline industry's gross plant by the end of 1970, the American Gas Association forecasts. With allowances for retirement of plants, the value will increase from $18.1 billion in 1958 to $49 billion.

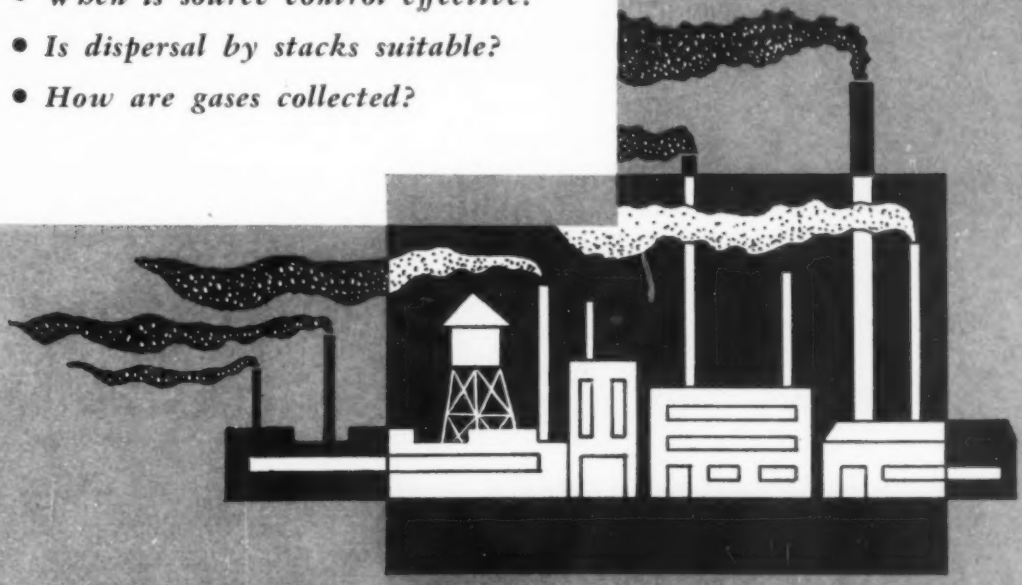
The AGA bureau of statistics estimates that $16.4 billion will be spent to expand transmission facilities, and $10.9 billion will be used for distribution system construction.

Expansion of production and local storage facilities is expected to require $3.4 billion over the 12-yr period, while underground gas storage projects will cost an estimated $2.3 billion. The remainder will be used for general construction. ∓

HPAC ENGINEERING DATA FILE

How to Control Gaseous Emissions To Abate Air Pollution

- *What gases are contaminants?*
- *What are criteria for control?*
- *When is source control effective?*
- *Is dispersal by stacks suitable?*
- *How are gases collected?*



Controlling emissions of objectionable gases and vapors from industrial and commercial processes is becoming increasingly more important in air pollution abatement. Gases and vapors acting individually or in combination are believed to be important in community air pollution because of their effects on health, atmospheric corrosion, soiling damage, and damage to vegetation.

In this report, the basic methods for controlling emissions of gases and vapors are presented. These methods include source control, dispersal by means of stacks, collection with suitable equipment, and zoning. The various types of equipment used to collect gases, how they perform, and where they have been used for air pollution control are also presented.

How to Control Gases and Vapors To Abate Air Pollution

GASES and vapors emitted by industrial and combustion processes contribute substantially to air pollution. Whether these emissions become an air pollution "problem" depends upon the quantity in which they are emitted, the ability of the local atmosphere to absorb and to disperse them, and the effects that they may have on the receptors of the contaminants. Gaseous pollutants are believed significant in relation to health, plant and animal damage, property damage, and nuisances.

In a previous report[1], the general aspects of air pollution control were discussed and four possible types of controls presently practicable were given. These included *source control,* which assumes that the basic process producing pollutants or that individual sources can be modified to eliminate the production of contaminants. Another is *effluent gas treatment* in which control equipment is applied to remove the contaminants from the exhaust gas stream. *Effluent gas dispersal* by means of tall stacks is a third control method that is successful when local meteorological and topographical conditions are such that contaminants do not accumulate and increase in concentration. Finally, *zoning* may be used to separate new from existing industries and to locate new industries where the contaminants emitted will have the least effect on the communities' atmosphere.

The choice of control method depends entirely upon local conditions and what works in one locality will not necessarily provide an acceptable solution in another. In some cases, only one of the four methods may be feasible from the standpoint of economics and the end result desired in terms of contaminant concentrations. Local conditions affecting the choice of control method[2] include topography, meteorology, legal requirements for emissions, and neighborhood requirements beyond specific legal limits.

In this report, consideration is given to some of the more common gaseous pollutants, their sources, and ways in which they have been controlled. It should be noted that the internal combustion engine — one of the chief sources of gaseous pollutants in metropolitan areas — is not considered in this report. These mobile sources of gases and fumes require a unique control device—though one that may employ principles applicable to control emissions from other sources.

What Gases Are Considered Contaminants?

Some of the gases and vapors that appear to be significant in community air pollution and that are common wastes of present day manufacturing or combustion processes include: carbon dioxide and carbon monoxide, sulfur dioxide and sulfur

[1]Numerals refer to references listed on page 126.

trioxide, nitrogen dioxide and nitrogen oxide, organic acids and partially oxidized organic compounds — gasoline vapors, solvents, thinners, bake oven exhausts and the like — hydrogen chloride, chlorine, and fluorine. The list could be extended to include many toxic gases, which when emitted in quantity must be controlled to prevent the occurrence of toxic ground level concentrations. Gases with noxious odors can also be included in a listing of pollutants.

Many Gases "Inventoried"

The list of specific gases and vapors that have been "inventoried" in air pollution source studies is lengthy. For example, in the inventory made[3] in the Louisville-Jefferson County, Kentucky industrial complex known as "Rubbertown" some 34 different gases were found to be emitted in varying but significant quantities. Industry in the area includes the manufacture of synthetic rubber, as well as the production of chlorinated compounds, miscellaneous organic chemicals, and the preservative treatment of wood — a process also involving organic compounds. It is interesting to note that only 9½ percent of the more than 10 thousand tons of gases emitted each month by industry in this area were traced to manufacturing processes. The major portion — more than 88 percent — was traced to the combustion of coal and natural gas for power generation, and space and process heating. The gases associated with combustion includes: carbon oxides, sulfur oxides, nitrogen oxides, aldehydes, organic acids, ammonia, and unburned hydrocarbons. About 50 percent of the contaminant gases from combustion were oxides of nitrogen and sulfur.

The Louisville "inventory" serves only to indicate the complex nature of what's in a polluted atmosphere. The same gases might or might not

SELECTED DEFINITIONS OF TERMS from ASTM D 1356 — 58 T,[a]

Absorption — A process in which one material (the absorbent) takes up and retains another (the absorbate) with the formation of a homogeneous mixture having the attributes of a solution. Chemical reaction may accompany or follow absorption.

Adsorption — A physical process in which molecules of gas, of dissolved substances, or of liquids, adhere in an extremely thin layer to the surfaces of solid bodies with which they are in contact.

Aerosol — A dispersion of solid or liquid particles of microscopic size in gaseous media, such as smoke, fog, or mist.

Air at Normal Conditions — (Standard Air) — Air at 50 percent relative humidity, 70 F and 29.92 in. Hg (21 C and 760 mm Hg). These conditions are chosen in recognition of the data which has been accumulated on air-handling equipment. They are sufficiently near the 25 C and 760 mm of Hg commonly used for indoor air contamination work that no conversion or correction ordinarily need be applied.

Count Median Size — A measurement of particle size for samples of particulate matter, consisting of that diameter of particle such that one half of the number of particles is larger and half is smaller.

Dust — A loose term applied to solid particles predominantly larger than colloidal and capable of temporary suspension in air or other gases. Dusts do not tend to flocculate except under electrostatic forces; they do not diffuse but settle under the influence of gravity. Derivation from larger masses through the application of physical force is usually implied.

Dust Loading — An engineering term for "dust concentration," usually applied to the contents of collection ducts and the emission from stacks.

Efficiency, Fractional — The mean collection efficiency for specific size fractions of a contaminant. Commonly this term has been applied to the performance of air cleaning equipment towards particulate matter in various size ranges.

Fly Ash — The finely divided particles of ash entrained in flue gases arising from the combustion of fuel. The particles of ash may contain incompletely burned fuel. The term has been applied predominantly to the gas-born ash from boilers with spreader stoker, underfeed stoker, and pulverized fuel (coal) firing.

Fume — Properly, the solid particles generated by condensation from the gaseous state, generally after volatilization from melted substances, and often accompanied by a chemical reaction such as oxidation.

be found in another industrial city. Those that are related to manufacturing processes vary with the industry present. For example, light metalworking industries would produce different gases from those emitted by processes in Rubbertown. In a given area, or more specifically in a given plant, a materials balance on the products entering and leaving the plant will sometimes provide an indication of the many contaminants that can be emitted and those that can become a neighborhood or community problem.

Combustions' Contribution

The pollutants from combustion sources are present in almost every community. The quantities of each pollutant emitted vary with type of fuel used and the chemical composition for any type. In assessing community air pollution, the approximate emissions of the two more important contaminants emitted by combustion processes — sulfur oxides and nitrogen oxides — for given quantities of fuel can be estimated from the following[4]:

Sulfur oxides (estimated as sulfur dioxide)

1) Coal burning — 40 lb per ton of coal. This is based upon an average sulfur content of coals of about 1.5 percent.

2) Fuel oil — 30 lb per 1000 lb of oil. This is also a function of sulfur content and the rate for residual oils would be higher than this average value.

3) Natural gas — only trace amounts of sulfur oxides are present in the flue gases of natural gas-fired equipment.

Nitrogen oxides (estimated as nitrogen dioxide)

1) Coal burning — 8 lb per ton of coal.

2) Fuel oil — 13.5 lb per 1000 lb of oil.

3) Natural gas — 6 to 9 lb per 1000 lb of gas.

These are average values and, as such, are use-

"Tentative Definitions of Terms Relative to Atmospheric Sampling and Analysis"

Fumes flocculate and some times coalesce. Popularly, the term is used in reference to any or all types of contaminant, and in many laws or regulations with the added qualification that the contaminant have some unwanted action.

Isokinetic — A term describing a condition of sampling, in which the flow of gas into the sampling device (at the opening or face of the inlet) has the same flow rate and direction as the ambient atmosphere being sampled.

Mass Concentration — Concentration expressed in terms of mass of substance per unit volume of gas or liquid.

Mass Median Size — A measurement of particle size for samples of particulate matter, consisting of that diameter such that the mass of all larger particles is equal to the mass of all smaller particles.

Mist — A loose term applied to dispersions of liquid particles, the dispersion being of low concentration and the particles of large size. In meteorology, a light dispersion of water droplets of sufficient size to be falling.

Odor — That property of a substance which affects the sense of smell; any smell; scent; perfume.

Odor Concentration — The number of unit volumes which a unit volume of sample will occupy when diluted to the odor threshold.

Particle Concentrations — Concentration expressed in terms of number of particles per unit volume of air or other gas. Note: — On expressing particle concentration the method of determining the concentration should be stated.

Particle Size — An expression for the size of liquid or solid particles expressed as the average or equivalent diameter.

Particle Size Distribution — The relative percentage by weight or number of each of the different size fractions of particulate matter.

Smoke — Small gas-borne particles resulting from incomplete combustion, consisting predominantly of carbon and other combustible material, and present in sufficient quantity to be observable independently of the presence of other solids.

Sorbent — A liquid or solid medium in or upon which materials are retained by absorption or adsorption.

Sorption — A process consisting of either absorption or adsorption.

Volume Concentration — Concentration expressed in terms of gaseous volume of substance per unit volume of air or other gas usually expressed in per cent or parts per million.

[4]*Reproduced by permission of the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.*

ful only in assessing the magnitude of the emissions from combustion sources. They can be applied to gross fuel consumption figures to indicate the total emissions expected from combustion processes. For example, for heating in the U. S. in 1958, about 105 million tons of coal and 492 million barrels of oil were consumed. The total emission of sulfur oxides from these two fuels would approximate some 2.3 million tons annually. For the same fuels, the emission of nitrogen oxides would amount to about ½ million tons annually.

The amount of contaminants emitted by these sources in metropolitan areas together with the combustion of fuels for power generation may in the future lead to restrictions on their use. Some indication of this is evidenced by the regulations imposed by Los Angeles on high sulfur content fuels and more recently by proposed changes in the New York City control legislation. It has been estimated that as much as 1.5 million tons of sulfur oxides are emitted by all sources in New York annually. Individual heating plants are relatively small sources of contaminants but, like the automobile, when taken collectively they can be important sources of both gases and particulates in community air pollution.

Criteria for Control of Gaseous Emissions

There are a number of factors that can serve as the criteria for determining the need for air pollution control[5]. These include vegetation and paint damage, eye irritation, malodor, visibility, soiling, and toxicity. To this can be added corrosion due to atmospheric weathering[6,7]. Each gaseous pollutant has its own scale of values for each of these characteristics. Their effects on a community may be exerted individually or in combination. Additionally, the byproducts of atmospheric chemical reactions between the pollutants present may also contribute to a community problem.

Few Limits Set For Gases

While most air pollution control ordinances specify maximum emission rates for particulate pollutants, they are vague with reference to the emission of gaseous pollutants. The control of other than particulate pollutants and smoke is usually included in a general nuisance statement such as the following entry found in the New York City code:

> "No person shall cause, suffer or allow to be emitted into the open air from any fuel or refuse burning equipment . . . . . any air contaminant, harmful or objectionable substance, including but not limited to smoke, soot, fly ash, dust, fumes, gases, vapors, nuisance odors that may be a detriment to the property of others or that may be a nuisance to any person not being therein or thereupon engaged."

This provides the enforcing agency with a tool to eliminate local problems within their jurisdiction without imposing expensive controls on other industries or sources that are causing no apparent problem though they emit the same contaminants. Where known sources of pollutants contribute substantially to a community pollution problem, as in Los Angeles County, specific requirements are established for specific contaminants or sources. This assumes a very complete community survey of sources and contaminant emissions, and some knowledge of their effects on the receptors in a community and the atmospheric reactions that occur. These are expensive surveys and have as yet been conducted in only a few cities. Surveys like these provide a great deal of information applicable to the area in which they are made and, to a somewhat lesser extent, to the knowledge of nation wide air pollution.

The hesitancy to specify limiting emissions for gases reflects present knowledge of the effects — especially on human health — of long term exposure to low concentrations of the many contaminants that find their way into the atmosphere. Evaluating these effects will require long term research programs and some phases of these are underway. The evaluation of acceptable ground level concentrations, which can then be translated to permissible concentrations in stack gases, is necessary to justify the economic burden of controls. It may be that such levels will be determined by considerations other than health for some gases. The cost of corrosion caused by some gases may determine the economic control level.

For others, it may be the effects on vegetation or animals.

MAC Values Only Starting Point

From the standpoint of health, the maximum allowable concentrations or threshold limit values established by the American Conference of Governmental Industrial Hygienists as a guide for the control of industrial health hazards indicate the magnitude of the concentrations which are of concern in air pollution abatement[8]. The publication of these values is prefaced by the following: "*They* (the limits) *are not intended for use, or for modification for use, in the evaluation or control of community air pollution or air-pollution nuisances.*" This statement reflects the basis on which these limits are determined. These take into account the exposure of healthy workers and exposure only during normal working periods. In air pollution, the total population with its wide variation in ages and health is exposed and, for this reason, the limiting concentrations will be much lower. Bearing in mind that these values should not be used as criteria in air pollution abatement, the MAC values for some of the common air pollutants are given in Table 1 to indicate the order of magnitude of the concentrations which can be significant in air pollution.

Sulfur dioxide it will be noted has a MAC of 5 parts per million (ppm) by volume. More information has probably been recorded for this pollutant than for any other gas and one suggested limiting ground level concentration for atmospheric pollution is 0.5 to 0.75 ppm[9]. On the other hand, plants can suffer considerable damage[10] at concentrations of 0.25 to 0.40 ppm while concentrations of 0.10 to 0.20 ppm appear to have no adverse effect on them. Where large volumes of sulfur dioxide are emitted by single sources, controls are usually imposed to avoid ground level concentrations in excess of the 0.10 to 0.20 ppm value. Thus, where control of this pollutant has been imposed, the limiting value is much less than the MAC value and, in this case, determined primarily on the basis of damage to vegetation rather than the effects on health.

Table 1 — THRESHOLD LIMIT VALUES or maximum allowable concentrations recommended by the American Conference of Governmental Industrial Hygienists as guides for the control of industrial health hazards are listed here for some common air pollutants. These concentrations cannot be applied to the control of community air pollution but they indicate the magnitude of the concentrations of concern. Threshold limit values are based upon exposure of workers during normal working periods. In community air pollution, the total population is exposed including infants, aged and chronically ill individuals. When limits are established for air pollution control, they will be much lower than the values given here

Substance	Maximum allowable concentration, ppm*
Acetaldehyde	200
Carbon dioxide	5000
Carbon monoxide	100
Chlorine	1
Formaldehyde	5
Gasoline	500
Hexane	500
Hydrogen chloride	5
Hydrogen fluoride	3
Nitrogen dioxide	5
Ozone	0.1
Perchlorethylene	200
Sulfur dioxide	5

*Parts of vapor or gas per million parts of air

Plants Indicate Pollutant Gases

It should be noted that plants can be used as indicators of air pollution because they are sensitive to low gas concentrations and the damage differs for different gases[11]. That is, pollutant gases are absorbed selectively and the damage to one type of plant may not occur in another. Some of their advantages as indicators of pollution include:

1) Any damage that occurs is recorded as long as the plant continues to grow.

2) They provide a qualitative and an approximate quantitative indication of the pollutants present.

3) Each toxic gas has its own symptoms and different plants have different sensitivities.

4) Good correlation has been shown between concentration of pollutants and the amount of leaf damage.

5) When large numbers of plants are available for survey, a trace of the damaged area can be used to determine the offending source.

An excellent discussion of the effects of specific contaminant gases on plants is given in Reference 12.

In the control of malodors — a nuisance aspect of air pollution — the concentrations of concern may be very small. A comprehensive listing of the

concentrations of malodors producing perceptible odor,[13] shows concentrations ranging from 0.000-0018 oz per thousand cu ft of air for ethyl seleno mercaptan to 0.059 oz per thousand cu ft for butylene.

Since the limiting ground level concentrations have been established for relatively few gases and vapors, each abatement problem must be given careful study to determine the degree of control required. In existing situations, analysis of the neighborhood complaints, measurement of the concentrations of pollutants present where this is possible, and reference to the literature on the effects and control of the contaminants present will provide a basis for establishing the degree of control required. As more knowledge is gained through surveys and studies of the effects of the different gases that can cause problems, limiting emission rates for more pollutants will undoubtedly be established.

Control of Gaseous Emissions

In the selection of the method or equipment to abate air pollution by gases, the factors given in the June HPAC Engineering Data File must be considered. Briefly these include, the *character* and *concentration* of the gas, the *temperature* of the exhaust gas stream, *disposal* of the material collected, *safety hazards* that arise in collection, and the *economic factors* involved in control. Also, *flexibility* in design should be considered to permit adjustments in the system as operating experience is gained or local requirements change.

In the broad classification of control methods, *source* control, effluent gas *dispersal* by suitable stacks, and effluent gas *treatment* are possible methods of abating pollution by gases. Each has its application and should be considered in any situation.

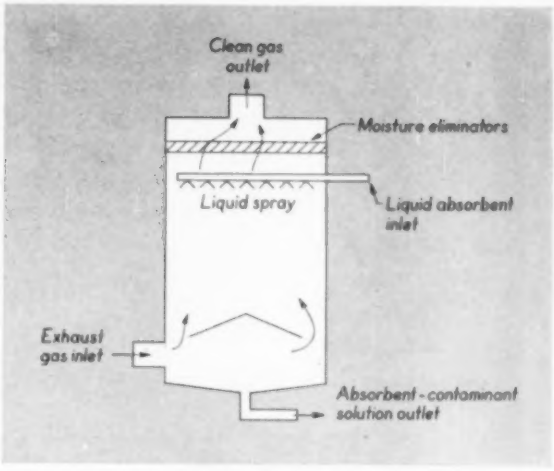
Source Control of Pollutant Gases

Controlling gaseous emissions at the source can range from complete abandonment of a process in extreme cases of pollution to the substitution of less offensive materials in the process where this is economically and technically feasible. In many cases, substitution of materials in a process will not be possible, but this should not be overlooked as a means of controlling gaseous emissions.

Source control is one means of reducing the sulfur dioxide pollution resulting from the combustion of fuels. This can presently be imposed, as it has been in Los Angeles, as a requirement that only low sulfur fuels may be used during critical weather periods. This is an extreme measure in the sense that it eliminates the use of fuels containing sulfur which by present technology cannot be economically removed. In Los Angeles, only the lighter grades of fuel oils and natural gas can meet the specified limitation of 0.5 percent sulfur by weight. From the standpoint of comfort heating, this restriction is not too severe since at present it applies only from May 1 to October 31. Control of sulfur dioxide pollution by this means may also be self imposed, as it has been in the chemicals industry in many cases[5] to eliminate sulfur dioxide pollution from the combustion of fuels for steam generation.

In the case of combustion processes, source control to minimize sulfur dioxide pollution may also come about through discovery of methods of reducing the sulfur content of fuels. The sulfur content of light fuel oils is reduced during production and this contributes substantially to minimizing pollution from this source. The removal of sulfur from the residual oils is not presently practicable though ways of doing so are being sought. Some coals can be beneficiated to relatively low sulfur contents, others cannot. Methods of reducing the sulfur content of coals are also under study. At present, no economically feasible processes are known for reducing the sulfur content of either coal or residual oils.

Eliminating sources of emissions may also take other forms not involved directly with the process. One of the more common types of pollution arises from general plant ventilation.[14] This can often be traced to poor housekeeping and poor maintenance or both. Where the offending materials are piped, elimination of leakage due to faulty valve stem packings, pump seals, etc. can



1 SPRAY TOWER is one type of absorber used to remove objectionable gases from waste gas streams. Atomization of liquid absorbent, and uniform distribution of gas to provide maximum contact between absorbent and gas are necessary for effective cleaning of waste gas stream. Water is frequently used as the absorbent though in some cases other chemical solutions are necessary to increase collection efficiency. In all absorption processes, the waste liquid may have to be treated to prevent a secondary pollution problem. When wastes have product value, the absorbent-gas solution is processed and the absorbent reused

minimize the production of pollutants while improving overall plant operation. Locating and correcting such sources is a first important step in an abatement program.

Use of Stacks in Abatement

Abatement of air pollution through the use of tall stacks to disperse the gases, depends first upon local meteorology. The weather variables of wind, temperature, and humidity, and the stability of the atmosphere must all be considered. In cases where the atmosphere is very stable, as it is with subsidence inversions, the stack does not provide a means of abating air pollution. Topography and the relationship of the stack to surrounding structures also affect the dispersion that can be obtained by this means.

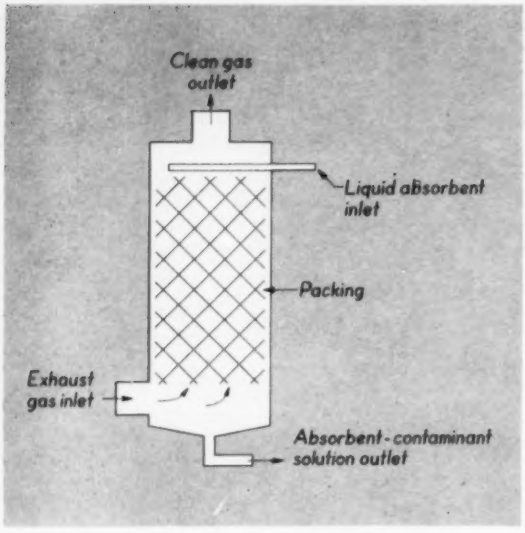
When stacks can be employed as a method of abatement, a number of factors in addition to local weather must be considered in design. These include knowledge of the rate and temperature at which the contaminants are emitted, and the toxicity, and chemical and nuisance properties of the contaminants.[15] When an existing stack is to be used for abatement purposes, its height and cross sectional area are also important considerations. Both of these variables affect the ground level concentrations that will result from a given emission. The area is important because the exit velocity must be sufficient to carry the plume beyond the vortices formed at the tip of the stack, as downwash from these could cause high ground level concentrations in the vicinity of the stack.

The ground level concentrations downwind from a stack depend to a greater extent upon the quantity of contaminant emitted than they do upon the concentration of the contaminant in the stack gases. Thus, even though the concentration of a pollutant in the stack gases may be very high, if the total volume of the stream is low, the ground level concentrations downwind will also be low. Dilution of the stack gases will not appreciably change the ground level concentrations at some distance from the stack although they may reduce the concentrations near the stack if all other factors such as temperature remain equal.

The effectiveness of a stack in abating air pollution can be predicted approximately by use of empirical equations[16] relating the rate of emission, stack characteristics, and weather variables to downwind concentrations. The methods outlined in Reference 16 will be useful in determining pollution caused by emissions from an existing stack or in determining the feasibility of employing a stack to abate an anticipated air pollution problem in a new system.

Control Equipment for Abatement

Application of control equipment to remove objectionable constituents from exhaust gas streams is, perhaps, the most obvious means of abating air pollution. In general, the equipment



2 PACKED TOWER is another means of contacting objectionable gas and absorbent. Ceramic rings, pebbles, tile, wood, and glass fiber pads are some of the packings used. When waste gas stream contains particulate matter, the tower has a tendency to plug up and must be cleaned periodically to maintain low pressure loss

used for this purpose can be divided into three major groups according to the process used to remove the contaminant gases or to convert them to unobjectionable forms. These include absorption, adsorption, and combustion or incineration. The latter class can be further subdivided into direct-fired and catalytic combustion devices. Each of the major classes will be considered individually and some applications of each will be given. More detailed information on the design of control equipment can be found in References 17, 18, and 19.

Absorption of Gases

In the absorber, the contaminant gases are removed from the exhaust gas stream by bringing the gas into intimate contact with a liquid in which the objectionable gas is soluble or with which the gas will react chemically. Solids are also used for absorption, but the more common liquid systems will be considered here.

Contact between the gases and the liquid is achieved by several means. The more common methods include impingement sprays, packed towers, jet scrubbers, and sieve or bubble plate columns.[14] The first three methods of providing contact between liquid and gas are most often used because they introduce relatively lower pressure losses than the bubble plate. Low pressure losses are usually important because large volumes of exhaust gases bearing light concentrations of contaminants must be treated in air pollution control.

The three common types of absorbers are illustrated schematically in Figs. 1, 2, and 3, respectively. There are many variations of each type, but the principle of operation remains the same. The spray chambers used for abating gaseous pollution are similar in many respects to the chambers used for the collection of particulate emissions. The degree of atomization achieved by the spray nozzles and the distribution of gas through the chamber are important. The contacting may be done either in counter flow as illustrated, or in parallel flow. The spray chamber is the least effective of the various types of absorption equipment. However, it has the advantage of being able to handle exhaust gases containing particulate matter without plugging.

The packing in absorption columns or packed towers may be of many different materials. These include[18] ceramic rings, pebbles, tile, wood, and glass fiber pads. These provide a large surface area of contact between the gas and absorbent liquid. The choice of material for packing depends upon the corrosiveness of the materials involved in the process and the economics of design. Gas and liquid are normally contacted in counter flow in the packed tower to achieve maximum absorption efficiency, but they can also be contacted in parallel flow. When used on gas.

streams carrying particulate pollutants, the packed tower has a tendency to plug up and must be cleaned periodically to retain low pressure losses. They are more difficult to clean than bubble plate towers and their advantages of low initial pressure drop may be offset by this. Removal of particulates from the gas stream before it enters the packed tower may be desirable when particulate concentrations are high.

The jet scrubbers are basically venturi nozzles and contacting is generally done in parallel flow. Gas flows through the venturi and the absorbent liquid is introduced in the throat of the nozzle. This same type of scrubber is also used to advantage for the control of particulate emissions.

In the selection of absorbers for air pollution control, some of the factors that must be considered[19] include:

1) The maximum flow of gas or vapor that will be emitted by the process to be controlled.

2) The composition of the gas stream including the concentration of the soluble gas to be removed.

3) The solubility of the gases in the absorbent liquid under conditions of operation.

4) The temperature of the gas and liquid streams entering the absorber.

5) The heat of solution or reaction in the absorption process.

6) The degree of collection required to meet local or neighborhood requirements.

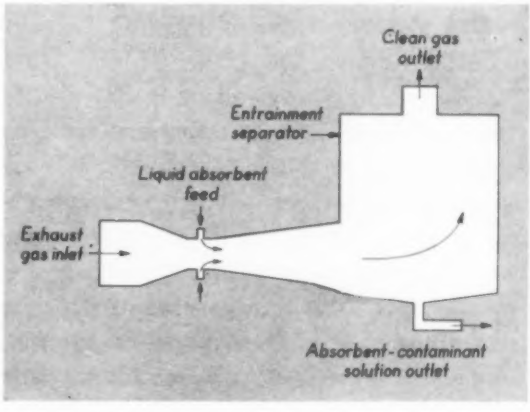
Water is most often used as the absorbent liquid, but many aqueous chemical solutions are used for specific gases. The latter are necessary when the contaminant gases are relatively insoluble in water or when other gases present interfere with absorption of the contaminant gas. Aqueous solutions and other chemicals are also used where the contaminant gases are collected in sufficient volume and have sufficient product value to make recovery of the product economically feasible. In these cases, the absorbent is regenerated and reused in the recovery process.

When gases are collected by absorption, they are collected either as liquids or solids. Disposal of the collected material may become a problem and must often be treated to avoid a secondary pollution problem.

Where Absorption is Used

Absorption as a control method is widely applied and a review of the specific applications would be extensive. Some applications made to abate air pollution by common gases are of interest.

Sulfur dioxide emissions have largely been controlled by absorption processes. A notable example of this is the collection of hydrogen sulfide emitted by oil refineries. Prior to application of such controls, the waste hydrogen sulfide gas associated with oil refining operations was burned and the resultant sulfur dioxide was emitted to the atmosphere. The waste gases are now processed in an absorption system employing amine solutions as the absorbents.[20] The hydrogen sulfide is collected in pure form which then is converted to sulfuric acid or sulfur. Aromatic amines are used to recover sulfur dioxide from the stack gases of smelters using sulfide ores.[21] In the latter application, the sulfur dioxide concentrations of the stack gases are not less than 3.5 percent.



3 VENTURI SCRUBBER used for absorbing objectionable gases contacts gas and absorbent in throat of a venturi nozzle. Gas-liquid mixture enters entrainment separator tangentially and centrifugal force separates liquid from waste gas stream. This same type of collector is also used to collect particulates

Absorption is also used to remove sulfur dioxide from the flue gases of a coal burning power plant in England. In the *Battersea* process,[22] Thames river water, which is slightly alkaline, is used as the absorbent liquid. Some additional alkalinity is achieved by adding chalk to the incoming water. The waste waters containing the sulfur dioxide are treated to neutralize them and returned to the Thames. This process increases operation costs by about 12 to 15 percent of the cost of the coal used.

A second process developed more recently in England is known as the *Fulham-Simon-Carves* process. This has been studied in a pilot plant and is in operation on a limited scale.[23] In this process, an ammonia liquor is used as the absorbent. The waste liquid is converted to sulfur and ammonium sulfate, both of which have product value. Preliminary results indicate the byproducts of the process when used for coals with sulfur contents of 1.5 percent or more will about pay the installation and operation costs of the plant.[24]

In general, scrubbing of flue gases with present processes for sulfur dioxide recovery will add considerably to the cost of operation. A concentration of sulfur dioxide in the flue gases of 0.5 percent or greater is needed for economic recovery.[26] Concentrations of sulfur dioxide in flue gases of boiler plants using coal and heavy oil are less than 1 percent and average[22] about 0.1 to 0.2 percent.

Two side effects of wet scrubbing of flue gases should be noted. The resultant cooling of the gases may impede[25] dispersal of the remaining contaminants since the gas will lose its buoyancy. The flue gas is saturated and an annoying visible plume can result due to condensation.

There are a number of other processes for the recovery of sulfur dioxide and these are reported in References 21 and 25. These are presently used for treating gas streams other than flue gases of combustion processes.

Absorption by water washing is also used to collect such pollutants as ammonia, hydrogen sulfide, hydrogen chloride, chlorine, hydrogen fluoride and many others arising from metalworking operations, chemical or metallurgical production, and other industrial processes. Absorption has also been used to remove nitrogen oxides from the exhaust gases of processes involving nitric acid. No processes have been commercially applied to remove the low concentrations of nitrogen oxides found in flue gases.

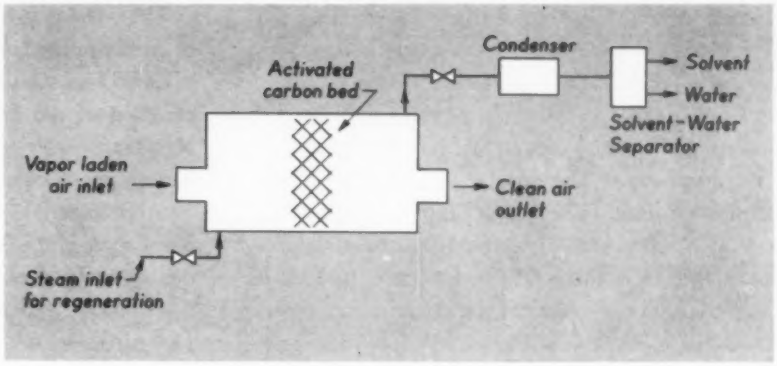
Purification by Adsorption

Gases and vapors adhere in thin layers to solid bodies with which they come into contact. This process is known as adsorption and it is often used to remove objectionable gases from waste gas streams. The adsorbent remains unchanged throughout the process.

Some materials are better adsorbers than others due to their surface structure. The better adsorbents are porous materials which expose a large surface area to the gas stream. Two well known adsorbents are silica gel, which is commonly used in refrigerant dryers, and activated carbon, which is used for air recovery in air conditioning systems. As silica gel tends to selectively adsorb water vapor it is not used for air pollution abatement. On the other hand, activated carbon selectively adsorbs organic vapors and is frequently used in air pollution control. Activated carbons, or activated charcoals as they are often called, are made from hard nut shells, wood, coal, or other carbonaceous materials.

In the adsorber, the exhaust gases are contacted with the activated carbon. The adsorbent bed is most often stationary and may consist of unit cells, canisters, or arrangements similar to packed towers. A short time is required for adsorption to take place, and the area and thickness of the activated carbon bed are varied to achieve the desired removal taking into account gas velocity, pressure loss, and economic factors. Adsorbers using activated carbon for solvent recovery can be designed[21] for nearly 100 percent efficiency.

After some period of usage, the activated carbon will become saturated with the contaminant and will no longer function. The amount of material held at saturation varies[27] with the gas or vapor collected. For heavier vapors, such as carbon tetrachloride it will take up from 20 to 50 percent of its own weight with an average value of about 30 percent. It takes up smaller quantities of light vapors. When the carbon becomes saturated, it must be regenerated. This is done by passing steam through the bed. The bed is heated in this way and the collected vapor is desorbed and carried off with the steam. The steam-solvent vapor mixture is condensed and the sol-



4 ACTIVATED CARBON adsorbers are used to remove vapors and odors from waste gas streams. Basic components of an adsorption system used to recover collected solvents are illustrated here. In a package unit available, one adsorption bed is used for recovering solvents from small scale operations such as dry cleaning. In large recovery systems, adsorbers are used in parallel so that one can be regenerated while the other is in operation

vent then separated from the water. When the solvent is not soluble in water, it is separated in a decanter which takes advantage of the difference in the densities of the two liquids. Distillation must be used to separate the two liquids when the solvent is soluble in water. Any steam or water vapor remaining in the activated carbon will generally be displaced[21] by the solvent when the unit is placed in operation.

Stable organic compounds with low boiling points, such as ordinary solvents, can be desorbed with low pressure steam. Carbon used for collecting these is often regenerated in place. Compounds that cause in-plant odors are often not easily desorbed. In this usage, the carbon is discarded or returned to the manufacturer for regeneration at high temperatures.

In large air purification systems for solvent recovery, two adsorbers are installed in parallel so that one can be regenerated while the other is in operation. Recently, a small packaged adsorber has become available that is suitable[28] for solvent recovery in small scale intermittent operations such as dry cleaning plants. These units employ one activated carbon bed. During regeneration, dampers installed in the air inlet and outlet are closed. Regeneration is accomplished by means of low pressure steam during periods when cleaning operations are shut down. The basic adsorption system is illustrated schematically in Fig. 4.

Some of the vapors that are adsorbed by activated carbon include: alcohols, acetone, benzene, carbon tetrachloride, ethyl acetate, gasoline, naphtha, and perchlorethylene to name just a few. A complete list of vapors that can be collected is given in the appendix of Reference 27.

In air pollution abatement, adsorbers have been used[20] for the collection of solvent vapors from cleaning plants, rotogravure printing processes, and paint mixing processes. Indirectly they have abated solvent emissions from many industries in which solvent recovery is essential to economic production. Some of these include[21] plants manufacturing cellulose acetate rayon, plastic coated paper and cloth, plastic films, and rubber products.

Adsorption is also used to abate atmospheric odors. The upper range of concentrations for practical[29] removal of odors is about 2 to 5 ppm. Higher concentrations require frequent regeneration and, therefore, high operating costs.

Adsorption of sulfur dioxide and nitrogen oxide has been studied[30] in the laboratory as a means of removing these pollutants from the flue gases of combustion processes. Charcoal of several types was studied, and the results indicated that the charcoal would adsorb about 8 percent of its weight in sulfur dioxide even after a large number of adsorption-desorption cycles. Nitrogen oxide was adsorbed in much smaller amounts. However, even though the process was considered a technical success, it was abandoned when estimated costs of a full scale plant indicated a prohibitive initial investment.

Combustion Converts Pollutants

Where high concentrations of organic materials are emitted that cannot be economically recovered, combustion has been used to convert the materials to unobjectionable compounds. Combustion processes are also used to deodorize materials causing odor pollution. The compounds resulting from combustion are in most cases discharged to the

atmosphere with the exhaust gas stream. In many instances, the products of combustion will simply be carbon dioxide and water vapor.

To meet good ventilation practice with respect to safety, solvent vapors are usually diluted to concentrations of one-quarter or less of the lower explosive limit. The lower explosive limits of common solvents range from 1000 to 100 thousand ppm by volume. Thus, the concentrations in properly diluted exhaust gas streams will range from 250 to 25 thousand ppm.

Two types of combustion equipment are used in air pollution abatement. One is the direct-fired afterburner in which the materials are incinerated, the other a catalytic oxidation device in which combustion takes place at lower temperatures than would normally be required. These are illustrated schematically in Figs. 5 and 6, respectively. Since the processes and application are different they are discussed individually below.

Direct-Fired Afterburners

In the direct-fired afterburner, the vapor to be incinerated is brought into intimate contact with the combustion gases. Good afterburner design[31] for incinerating dilute solvent vapors includes:

1) Intimate mixing of the vapor laden air stream with the combustion gases to achieve uniform heating of the vapor.

2) Increasing the average temperature of the mixture to the kindling temperature of the vapor.

3) Holding the gases at the necessary temperature for a long enough time to obtain complete oxidation of the vapors.

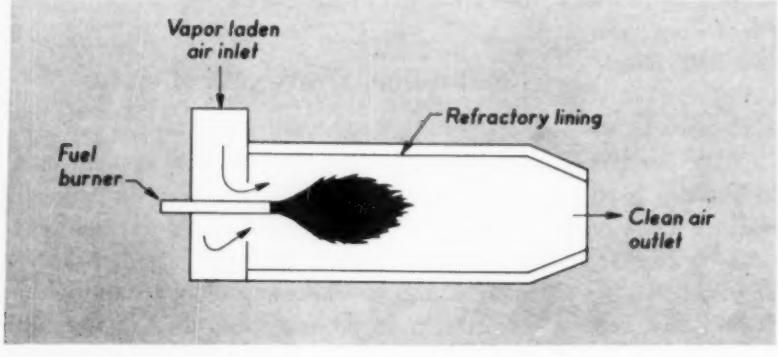
The temperature of the mixture must normally be in the range from 1200 to 1500 F. Large quantities of fuel are usually required to raise the temperature of the exhaust gas stream to this level. Heat input rate would approximate 10,800 Btu per hr per 100 standard cfm of exhaust air per 100 F temperature rise. In some cases, the combustible contaminants will contribute[29] significant quantities of heat to the process at concentrations found in the exhaust gas streams thereby reducing fuel requirements.

A residence time of one-quarter to one-half second and gas velocities of 900 to 1800 fpm have been reported[31] to provide satisfactory results. Efficiencies of oxidation of about 90 percent can be achieved[32] in such applications as incineration of solvents emitted from baking and drying oven exhausts.

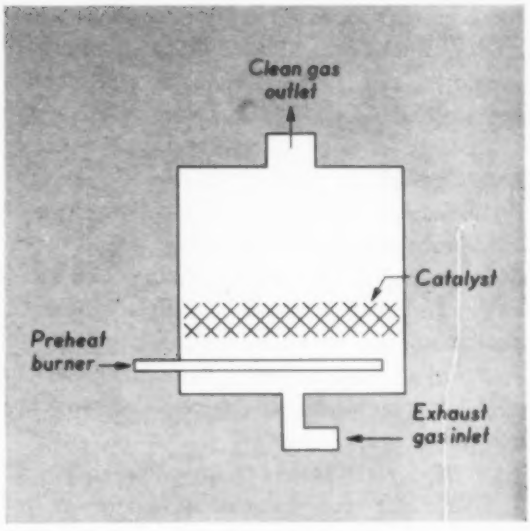
Other applications of direct-fired afterburners have been made[20] to control emissions from coffee roasters, varnish cooking kettles, meat smokehouses, and cooling ovens used in the manufacture of rock wool insulations.

Catalytic Oxidation

In catalytic oxidation, combustion of the objectionable vapors occurs at temperatures very much lower than those required in the direct-fired afterburner. Oxidation proceeds at temp ures as low as 500 F under the influence of the catalyst, which promotes oxidation. The catalyst does not enter into the end products of the oxidation and undergoes no physical change as a result of the reactions which take place.



5 DIRECT-FIRED AFTERBURNERS are used to incinerate organic vapors and odors. Fuel may be gas or oil. The temperature to which objectionable components are heated and the time that they remain in the afterburner are important factors affecting the efficiency of this device. Temperatures of 1200 to 1500 F are usually needed for complete oxidation of wastes



6 CATALYTIC OXIDATION devices employ platinum based catalysts to oxidize objectionable gases. Catalysts promote oxidation and reaction proceeds at much lower temperatures than those required in direct-fired afterburners. Preheat burner is necessary only when the oxidation reaction is not self-sustaining. Incoming gases are then preheated to the temperature required to initiate reaction — about 500 F. With suitable heat exchanger design, waste heat can be recovered before gases are exhausted to the atmosphere

Self-sustaining flames require minimum concentrations of vapor in air equal to the lower explosive limit. In catalytic combustion, a self-sustaining reaction will occur with concentrations as low as 15 to 20 percent of the lower explosive limit.[29] When concentrations are below this point, the exhaust gases must be heated to the temperature required to initiate oxidation. This temperature will be about 800 F. The minimum self-sustaining concentration can be reduced by recycling a part of the hot exhaust gases once the reaction is started.

Two catalytic combustion units are presently available and in use for air pollution control. One of these employs a platinum-alumina combination as the catalyst. The catalyst is bonded to porcelain rods which are mounted in a brick-like unit. The rods are spaced to permit gas flow through the assembly. The other employs platinum as the catalyst. In this unit, the catalyst is supported on a nickel alloy ribbon.

Catalyst life as determined by catalyst activity, is a function[29] of "poisoning" by trace contaminants, coating of the surface by deposit of carbon or other materials in the gas stream, and loss of the catalyst by abrasion due to particulate materials in the gas stream. Some of the "poisons" include[14] lead, zinc, arsenic, halogens and silicones. Useful catalyst life of more than 20,000 hr has been reported.[22]

Applications of catalytic combustion for the control of odors and organic emissions have been made in a number of industries. Some specific applications include control of emissions from lithographic and paint baking ovens,[20] ceramic kilns, foundry core baking ovens, and paint resin cooking kettles.[24] When either type of combustion device is to be used for odor control, pilot studies are often desirable to be certain of satisfactory results with the full scale plant.[29]

Nitrogen oxides in the effluents from nitric acid production and processes using nitrogen compounds and acid reacting processes are also controlled by catalytic decomposition of the oxides to nitrogen.[23] Catalytic removal of nitrogen oxides and sulfur oxides at concentrations found in flue gases of combustion processes has been studied and results indicate that a significant reduction in both can be achieved. However, the costs are presently so high that the process is not economically feasible.[30]

With either type of combustion device, waste heat can be recovered through the use of suitable heat exchange equipment, such as waste heat boilers and air heaters. These increase the capital cost of an installation, but in many cases will be justified by the savings in fuel that result.

Summing It Up

In this and the February and June HPAC Engineering Data Files on the subject of air pollution,

the general methods for controlling objectionable emissions have been presented. Since controls are expensive, each problem demands careful engineering analysis and design.

Much is yet to be learned about what permissible rates of emission should be — especially for gases and vapors. The effects of many gases, as has been indicated in this report, are not quickly recognized, as is dustfall resulting from excessive emissions of particulates. However, as information is accumulated from studies in both the field and in the laboratory, more guidelines are established on which an engineered control system can be based.

Of the several aspects of air pollution control that have not been discussed in this report, by-product recovery is one that should be briefly mentioned. This is an area in need of development. Many examples of profitable air pollution abatement systems can be cited[24] in which the product recovered has sufficient value to pay for the cost of control. But, many more examples can be found in which controls are an economic burden in the sense that the products recovered have no value. In these cases, the expense of control is balanced by potential improvement of health, and reduction in the costs of atmospheric corrosion, soiling damage, etc. The latter are difficult to evaluate and at present only "guesstimates" of their worth are available.

Although total air pollution may diminish in future years due to the effort expended to control it, the need for control can be expected to increase because of the intimate relationship between population and air pollution. Many of the wastes produced by the activities of the population and the industry serving its needs find their way into the atmosphere. Unless they are controlled, serious air pollution can result in centers of population.

[The editors wish to acknowledge the advice and guidance of the air pollution control officials and the engineers who have cooperated in the preparation of this report. Special acknowledgement is due Mr. Morris A. Fisher, chemist, Armour Research Foundation of the Illinois Institute of Technology for his guidance.]

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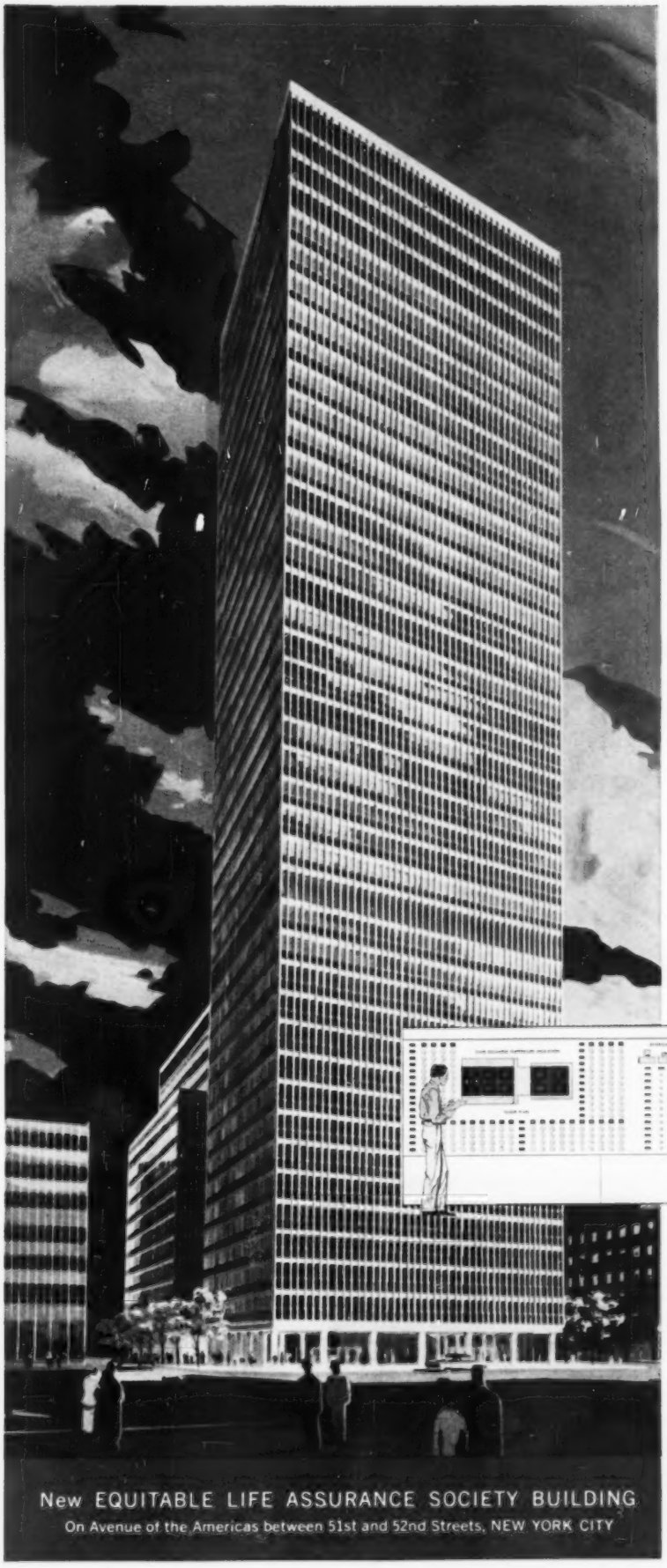

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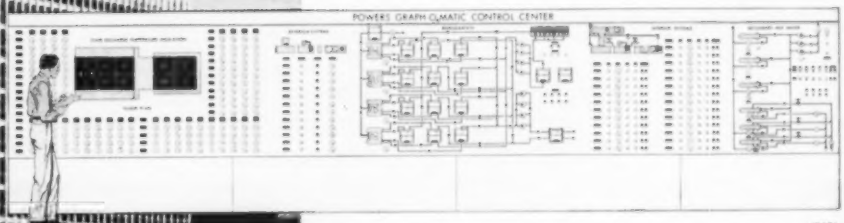

(D13)

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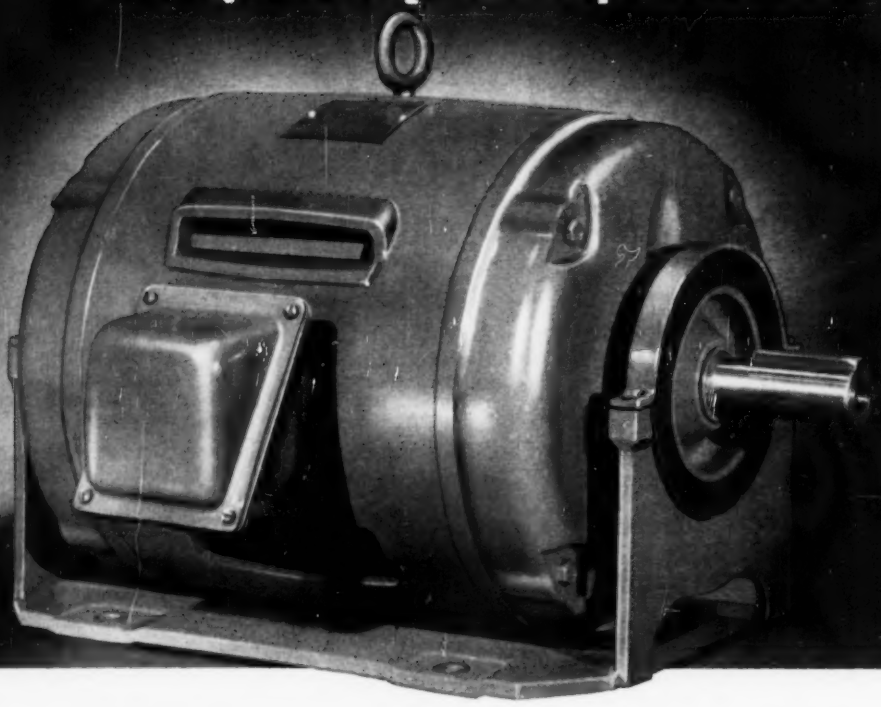

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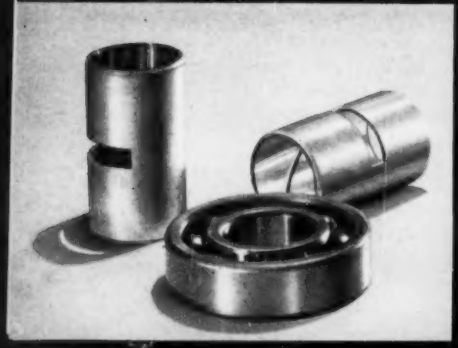

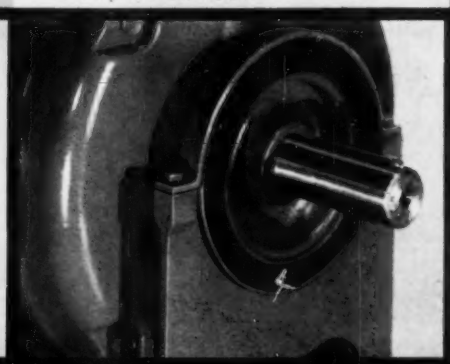

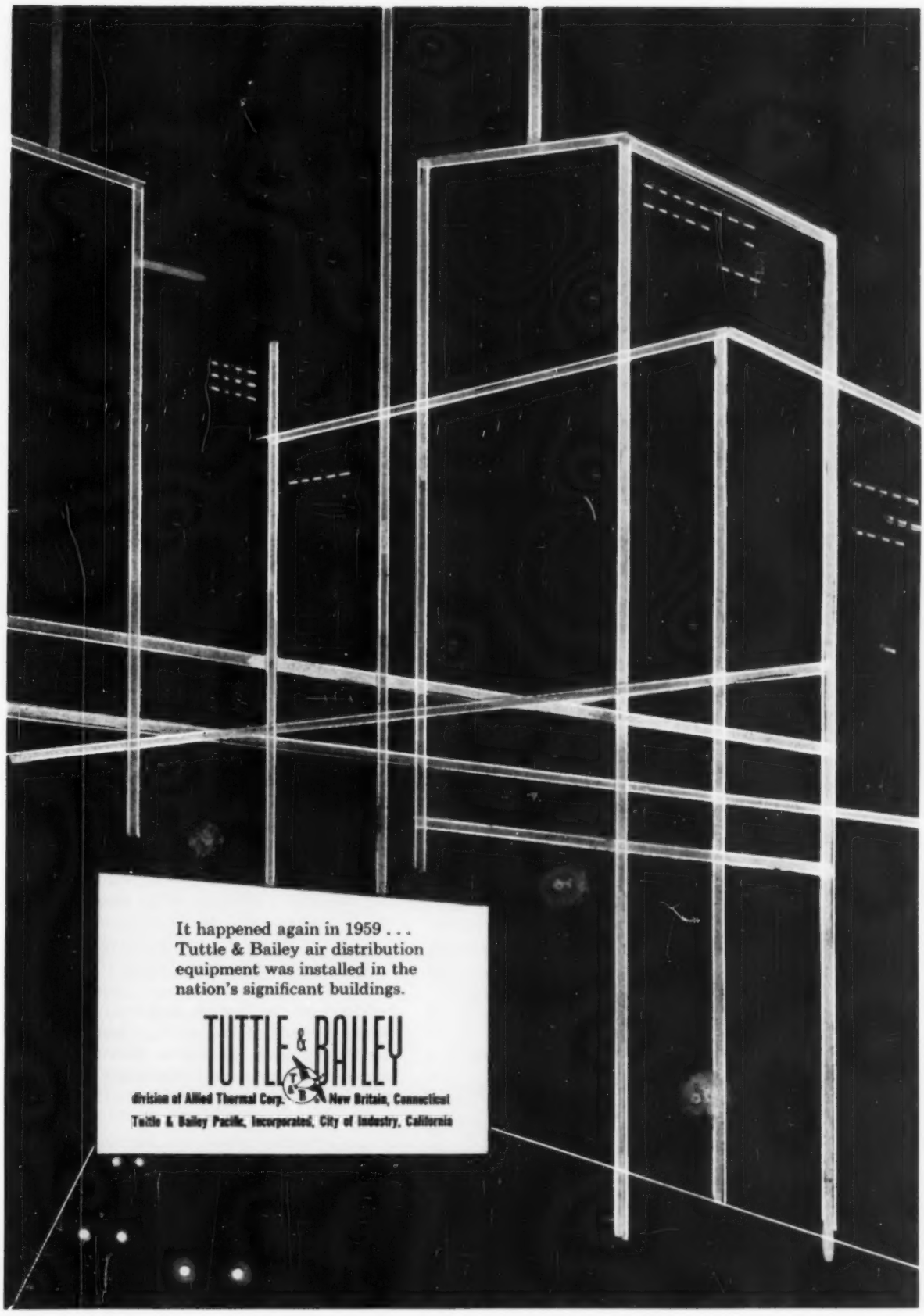
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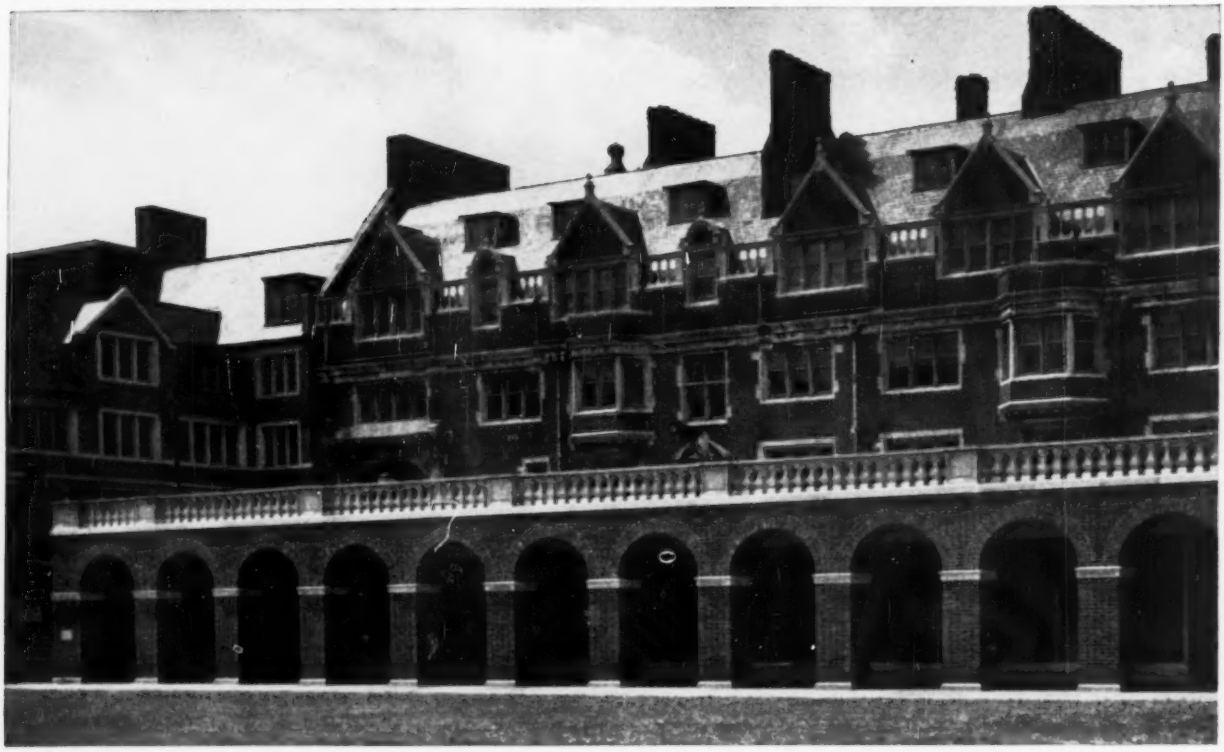

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McClelland's "men of Penn" aren't alone in their appreciation of Acme air conditioning . . . Mr. Robert McCray, Building and Grounds Department at the University, likes the excellent cooling and operational efficiency of the system . . . and Herman Goldner Co., Inc., contractors, were well pleased with the ease and simplicity of installation.

Acme, incidentally, is no "stranger" to the University of Pennsylvania because a number of other buildings on the campus including . . . Moore School of Electrical Engineering, Chemistry Building, Faculty Club and Univac Building . . . also contain Acme equipment. And small wonder . . . for the "acme" in air conditioning and refrigeration systems is Acme.

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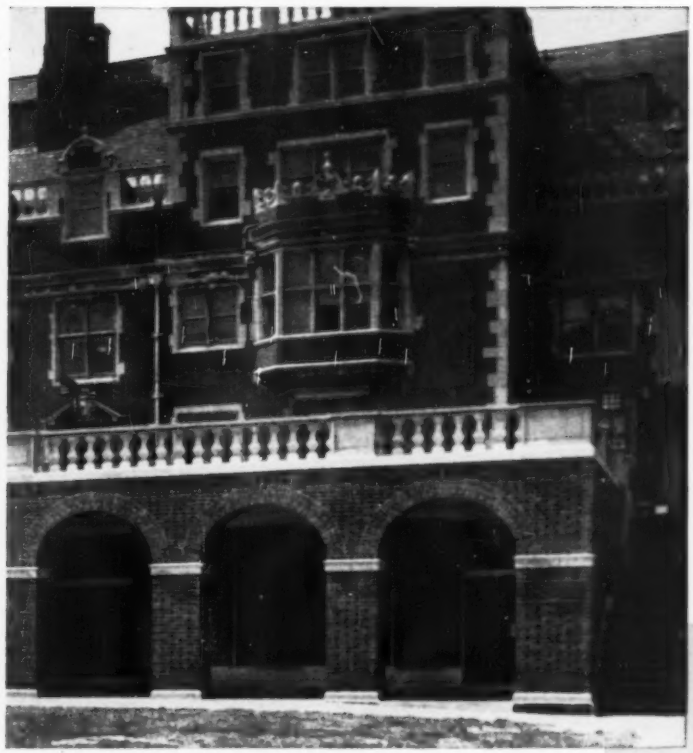

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Practical, is indeed the word for complete Acme air conditioning systems . . . practical from every standpoint. Take the Acme packaged chiller, evaporative condenser, and central station air handlers used in McClelland Hall's 60-ton system . . . each unit, thanks to Acme's out-in-front engineering, packs more capacity and efficiency in less space and weight than ever before. As a result, Acme system components save valuable building space . . . reduce structural requirements . . . cut installation time and costs to a minimum.

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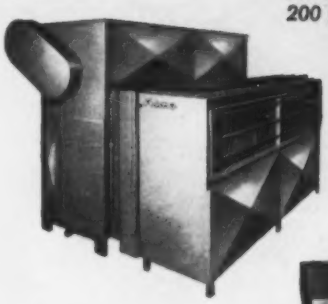

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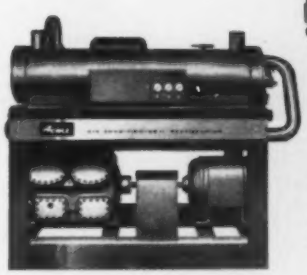

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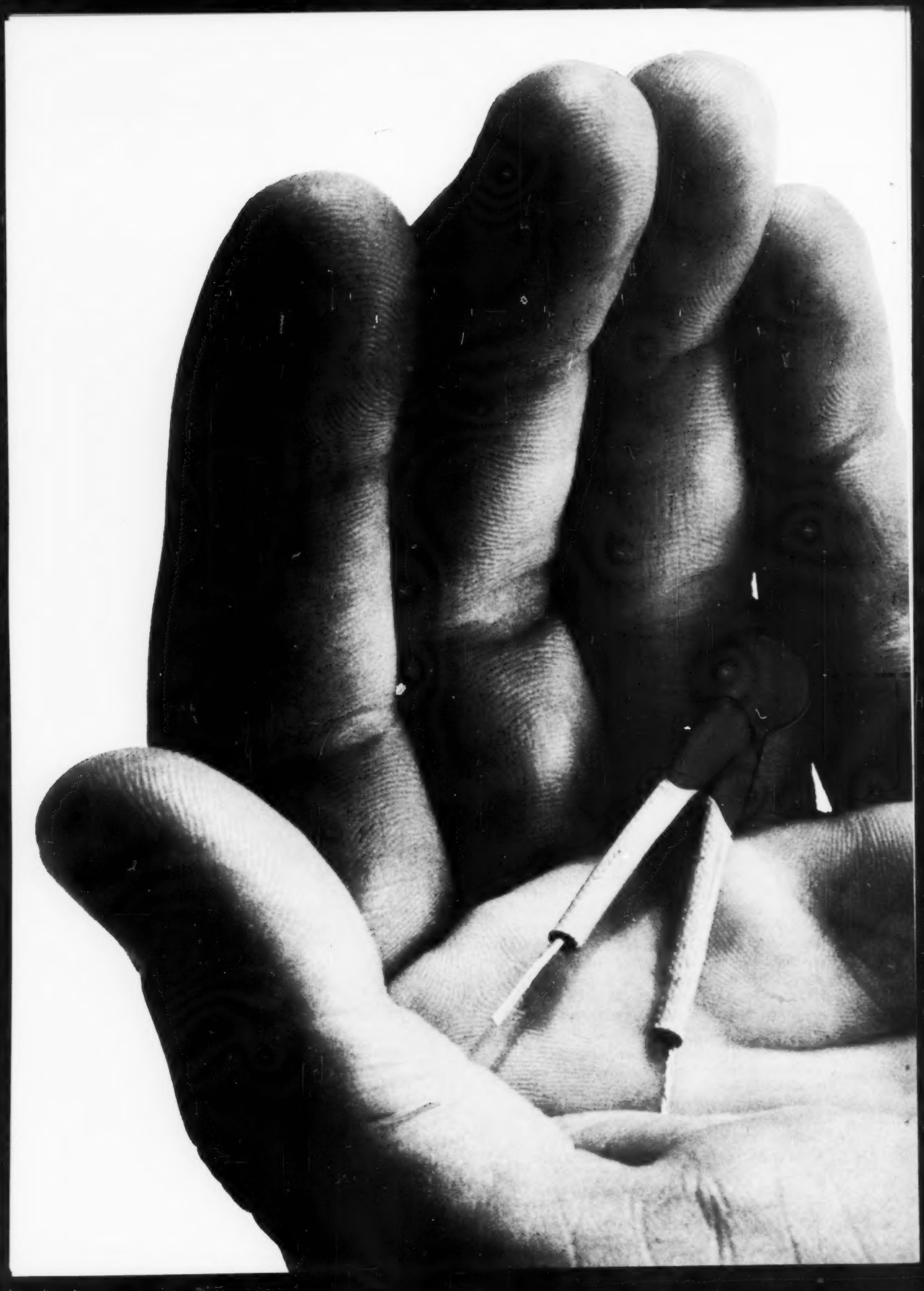

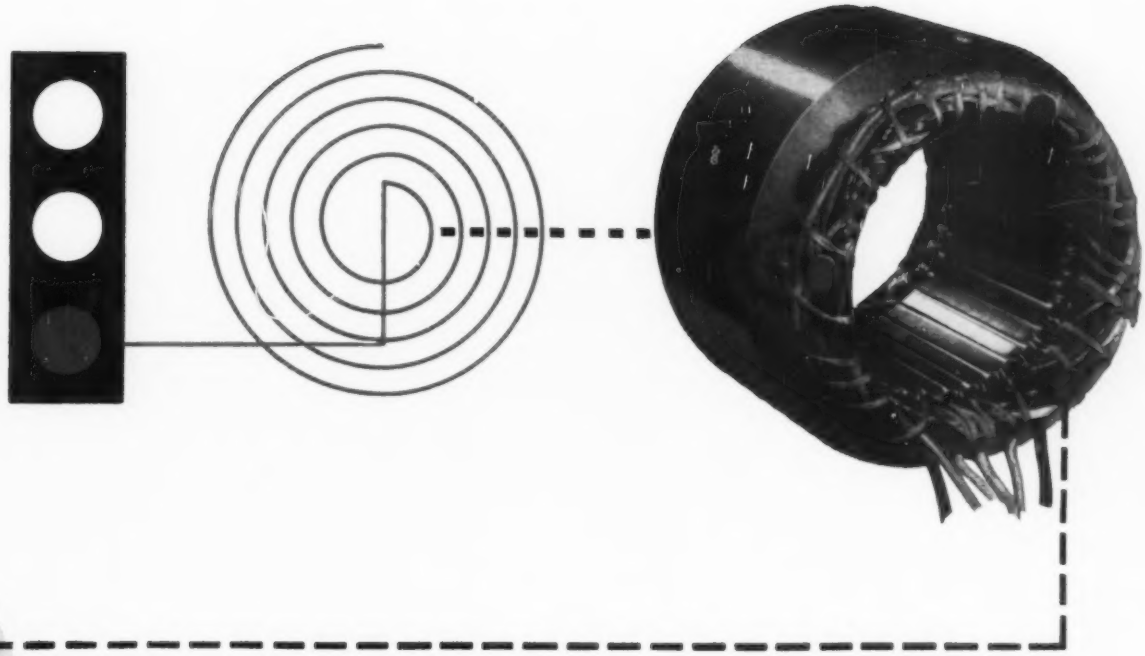

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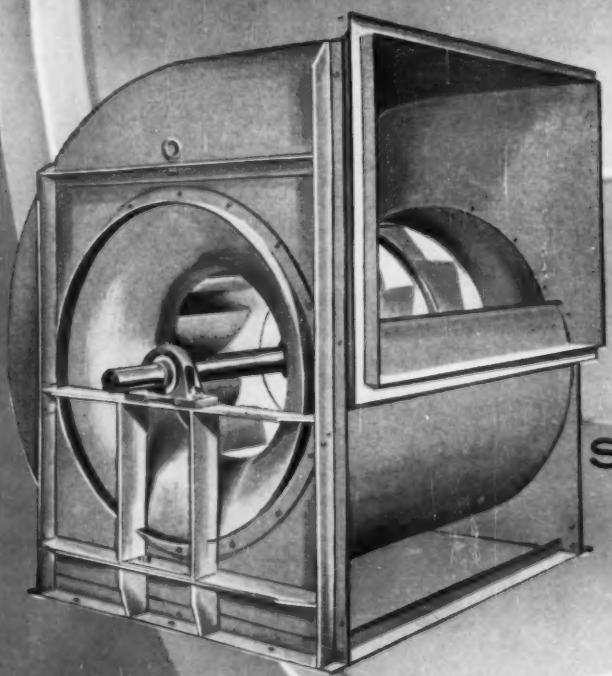

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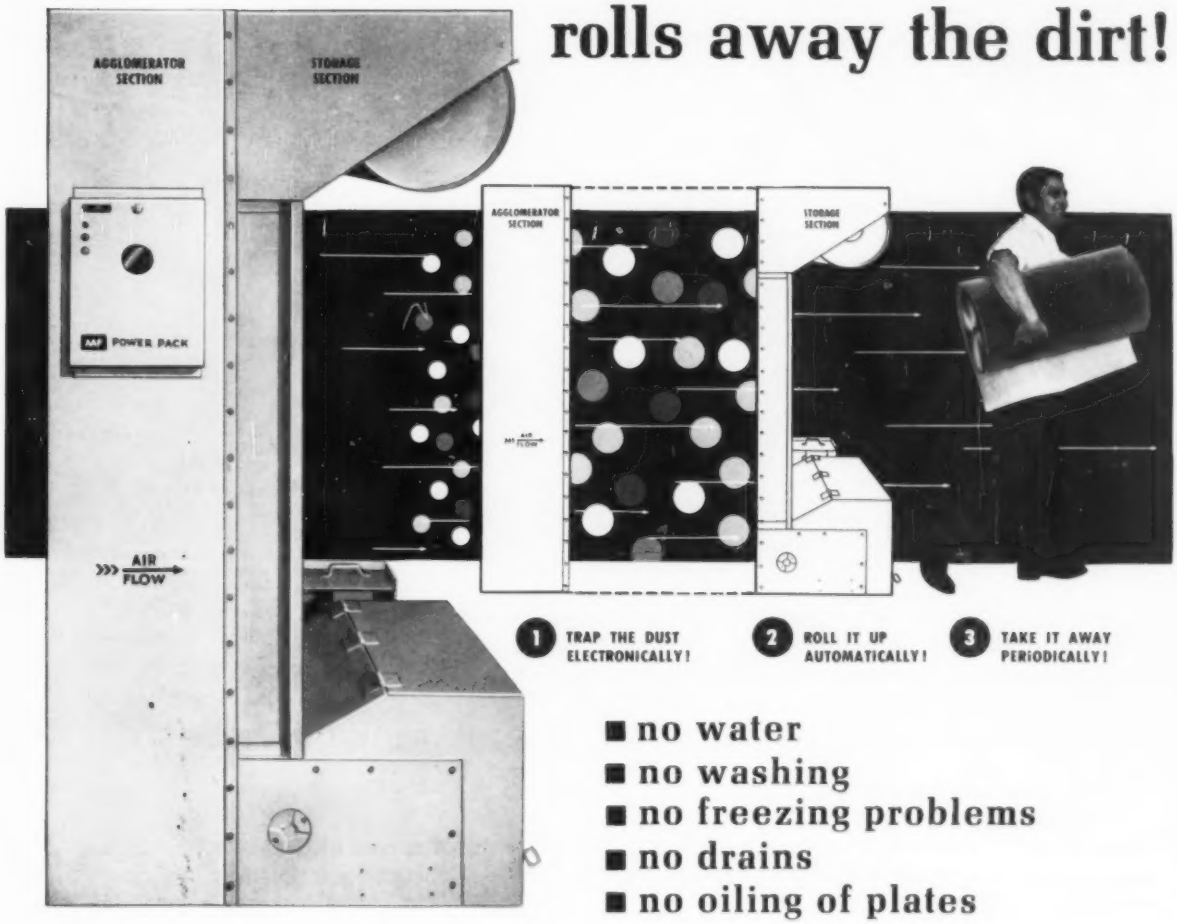

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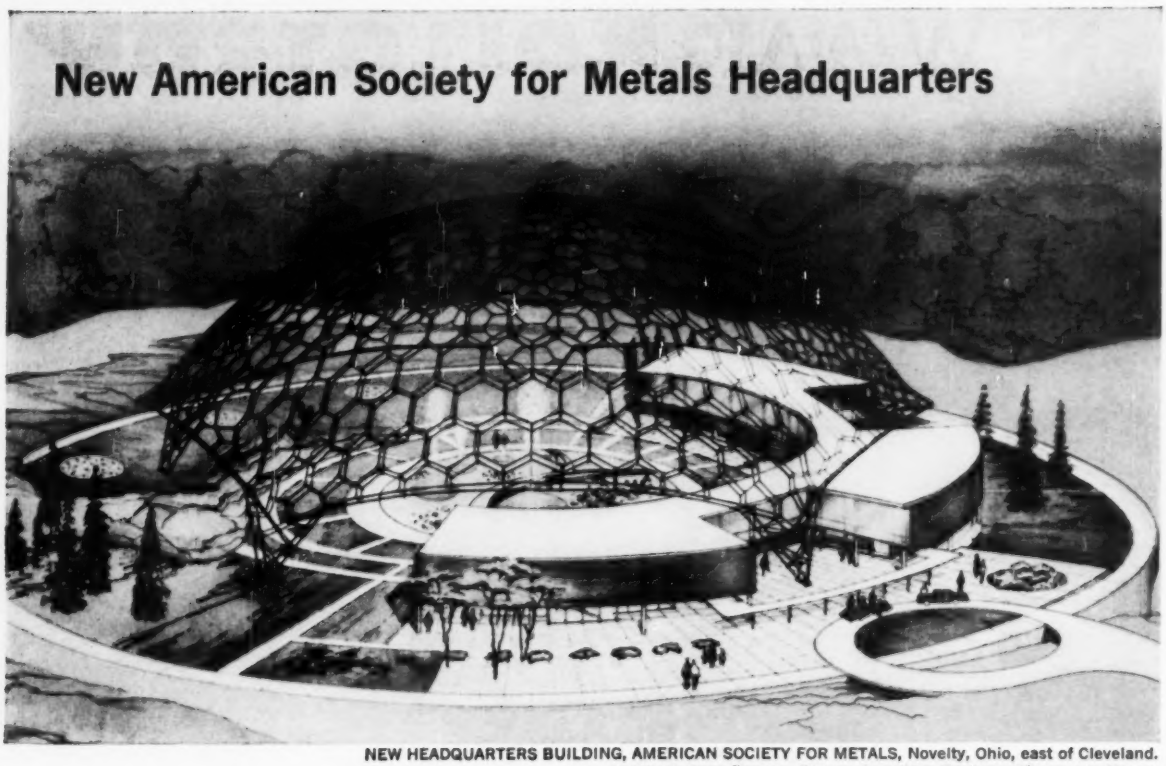

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EQUIPMENT DEVELOPMENTS . . .

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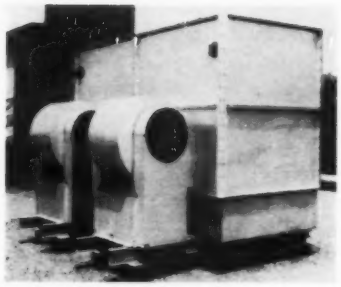

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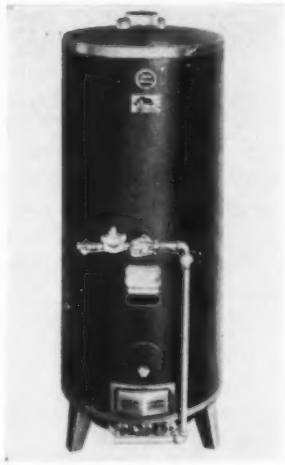

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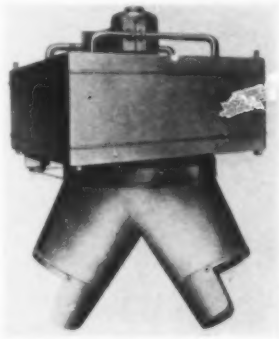

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. . . to prevent "hot spots"—*L. J. Wing Mfg. Co.*, 140 *Vreeland Mills Rd., Linden, N. J.*

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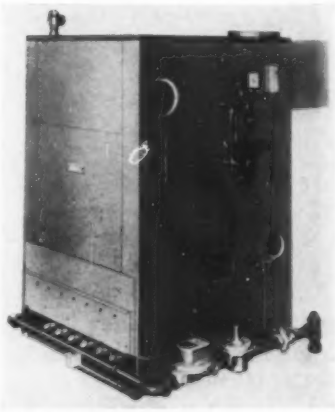

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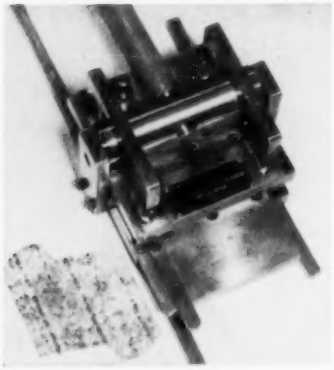
Chicago 5, *Illinois.*

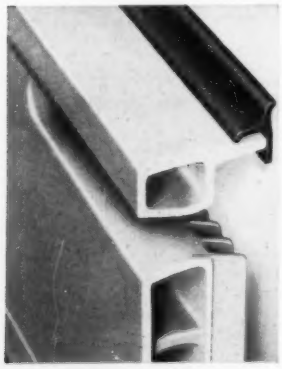
Designed for commerical installation with maximum input of 5.8 million Btu per hr; available in 36 sizes with staggered heat travel design for maximum heat transfer.



Hand Operated Shear . . .

. . . for bench mounting—*Fallsington Mfg. Co., Fallsington, Pa.*

Produces drive cleats, S-slips, government slips with rivet hole and prick punch marks, 90 deg notch; constructed of welded steel; contains 2 hardened pins and bunkings; die sections are of tool steel.



Baseboard Moulding . . .

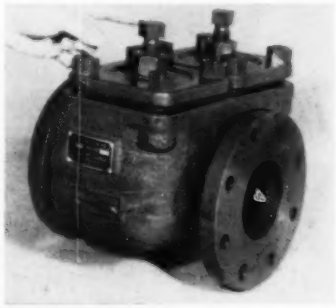
. . . requiring no nailing—*Weil-McLain Co., Michigan City, Ind.*

Features heat-proof extruded neoprene construction; installed by slipping extended skirt of seal between baseboard and wall; 45 deg joints for corners may be made with miter box furnished.

Water Heater . . .

. . . designed exclusively for commercial applications—*Commercial Heater Co., 3020 Galvez, Fort Worth 11, Texas.*

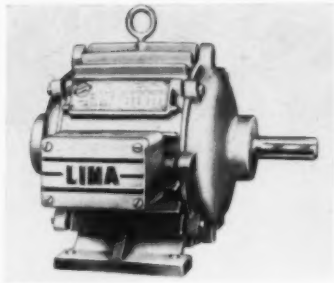
Available in nine sizes from 180,000 to 1.8 million Btu per hr input with 80 to 600 gal of self-contained storage; will handle delivery of hot water at temperatures up to 180 F; has recovery rate to 1500 gph at 100 F; descriptive bulletin "29-D-2" available on request.



Check Valves . . .

. . . using air cushion action—*Pennsylvania Pump & Compressor Co., Easton, Pa.*

Suitable for discharge lines 3/4 in. to 12 in. for pressures to 600 psig; can be installed in any position; inspected and renewal parts installed without disturbing piping.



Fan Motors . . .

. . . in 1800, 1200, 900 rpm speeds—*Lima Electric Motor Co., Inc., Dept. 519, Lima, O.*

Available for 2 or 3 phase operation in all standard frequencies and commercial voltages below 600 v; duty rating is continuous and temperature rise is 55 C; comes in rerated NEMA frame sizes 182 through 326 U in 1/2 through 15 hp.

Pipe Fastener . . .

. . . designed for electrical, hydraulic, and pneumatic lines that must be removed for maintenance—*TA Mfg. Corp., 4607 Alger St., Los Angeles 39, Calif.*

Variety of sizes from 1/4 to 6 in. diam of stainless steel; features hinge built into parent metal allowing clamp to be opened and closed without binding or distorting.

Unit Heaters . . .

. . . in 11 capacities from 25,000 to 300,000 Btu per hr input—*Reznor Mfg. Co., 51 Union St., Mercer, Pa.*

Combines low voltage anticipating thermostat with two-speed motor and automatic fan speed selector which operate independently of heater's burner controls; controls available with propeller fan type unit heaters.

AUTO AIRCON STEEL CABLE V-BELTS

Forget your experiences with V-Belts on air-conditioning units

The U.S. Auto AirCon Steel Cable V-Belt has everything required in a belt for air-conditioning use. Here is a V-Belt that's in a class by itself. It is equipped with pulling members of steel. A new p ented curing method and electronic tensioning of the steel cords free this belt from vibration. It transmits power smoothly, quietly and efficiently—and in present automotive air-conditioning service lasts 1½ to 2½ times longer than any other V-Belt. Here are the unequalled advantages the engineers point out:

- All-steel cable members lie in the same plane.
- Wire cable members are straight, never wavy.
- Absolute uniform top width and belt thickness for better seating in pulley.
- Perfect dynamic balance.
- Use of knurled mold insert provides maximum traction and alignment of outside idler.

Our transmission belt field engineers stand ready to consult with you on any or all V-Belt problems. Drop us a line at address below. . . .

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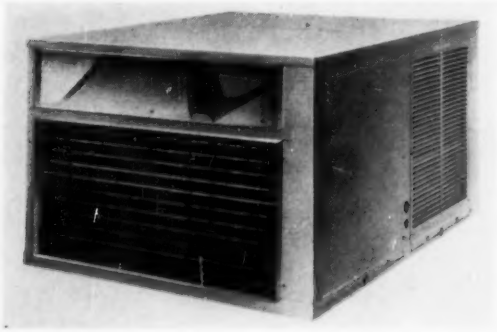
EQUIPMENT DEVELOPMENTS

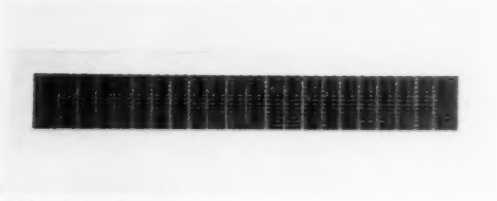
Continued



Heat Pump . . .

. . . built in one weatherproof cabinet suitable for commercial applications—*Carrier Corp., Syracuse 1, N.Y.*

New three ton size can be mounted on roof of commercial structure; auxiliary resistance heaters slip onto discharge side of unit when needed; operation is controlled by single thermostat; all electric controls mounted in one box.



Diffusing Grille . . .

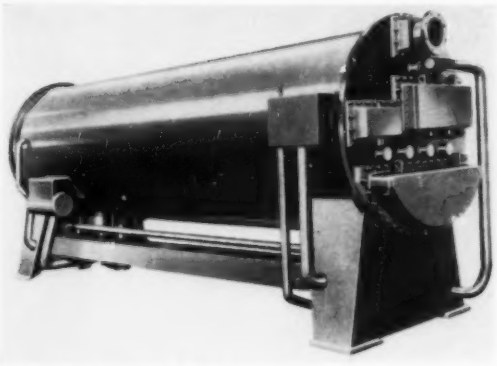
. . . to blend with modern architecture—*Barber-Colman Co.*, 1300 *Rock St., Rockford, Ill.*

Features aluminum flat flange incorporating adjustable core permitting adjustment of air pattern; furnished with 5 deg deflected vertical air pattern; can be altered up or down by inverting grille; installations, specifications in catalog "F 7757-1" on request.

Expansion Absorber . . .

. . . featuring piston within cylinder design—*Cobra Metal Hose*, 5059 *S. Kedzie Ave., Chicago* 32.

Foreign matter is kept from entering mechanism at end of cylinder by hygroscopic seal; available in ½, ¾, 1, 1¼, 1½ and 2 in. ID with female and male tube endings; smallest size will absorb expansion of 2 in.



Absorption Chiller . . .

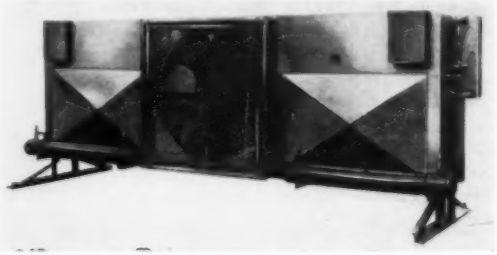
. . . with 100 to 350 ton capacities—*Trane Co., La-Crosse, Wis.*

Hermetic absorption unit is powered by low-pressure steam using water as refrigerant and lithium bromide as absorbent; catalog available describing operation, design, dimensions, and specifications.

Relief Valve . . .

. . . for use in process industries, power plants, and marine applications—*J. E. Lonergan Co.*, 211 *Race St., Philadelphia, Pa.*

Available with bellows if necessary to keep working parts away from contaminants, corrosives, or viscous fluids; bellows version available from 1½ to 8 in. sizes; plain valve is in 1 to 8 in. sizes.



Outdoor Compressor . . .

. . . packaged units come ready to install—*Kramer Trenton Co., N. Olden & Breunig Ave., Trenton 5, N.J.*

Features standard servicing components which are accessible from outside of unit; bulletin "460" gives all components, specifications, and nominal ratings.

B&W JOB-MATCHED WELDING FITTINGS

make piping systems permanent and leakproof

. . . you get positive fit-up to pipe which means welding is easier, faster and more sure

. . . you get dimensional accuracy which means that, with a sound weld, piping is maintenance-free for the life of the system

. . . you get extra long life because you can choose the correct steel for your application

Specify B&W Welding Fittings and Flanges on your next piping job. They're available in a complete range of types and sizes in carbon steel and, of course, the famous B&W CROLOYS. Call your local B&W District Sales Office or any qualified welding fittings distributor. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

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For Baseboard Heating or Cooling

STYLE NO. 40

Two-piece design, solid back frame that does not require a stack head. The circulating air is evenly distributed in a fan-shaped pattern, so that it moves out and up closely paralleling the wall surface. Three sizes—for 2¼" x 10", 2¼" x 12" and 2¼" x 14" openings. Overall size 18½" x 4½". Base extension 3¼". Open area 23 sq. inches. Furnished in prime coat or Fabritone finish.

STYLE NO. 60-A

For Floor Installations

The grille faces of these registers for floor installation are the famous "Fabrikated" construction, excelling in rigidity, open area and attractive appearance. Face bars made of solid steel bands #14 ga. x ½" deep, mill edges. Bars individually adjustable if desired. An adjusting screw allows air flow to be directed toward outer wall when valves are set in the correct position.

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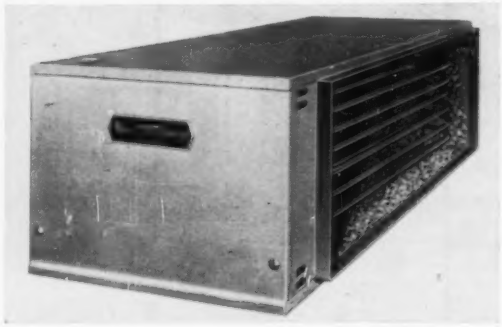
THE INDEPENDENT REGISTER CO.

3747 E. 93rd STREET • CLEVELAND, OHIO

EQUIPMENT DEVELOPMENTS

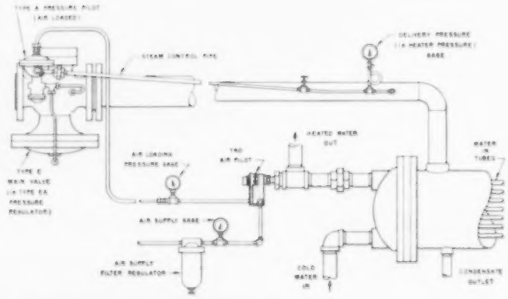
Continued



Heat Pump . . .

. . . in 3 and 5 hp models—*Mueller Climatrol Div., Worthington Corp., 2005 W. Oklahoma Ave., Milwaukee 1, Wis.*

Packaged units available in 8 and 12 kw heating capacities which deliver 27,280 and 40,920 Btu per hr; heating elements are sequenced through control panel which energizes elements in 4 kw increments; may be operated with or without duct system.



Temperature Control . . .

. . . for systems subjected to wide and sudden load swings—*Spence Engineering Co., Inc., 32 Grant St., Walden, N. Y.*

Control accuracy of 6 to 8 F; has load swings from 210 gpm down to 80 gpm while controlling temperatures to ± 5 F of set point; precise temperature control obtained from cascaded air system which loads pilot in main valve.

3-Way Valve . . .

. . . for pressure limit protection—*George W. Dahl Co., Inc., 86 Tupelo St., Bristol, R. I.*

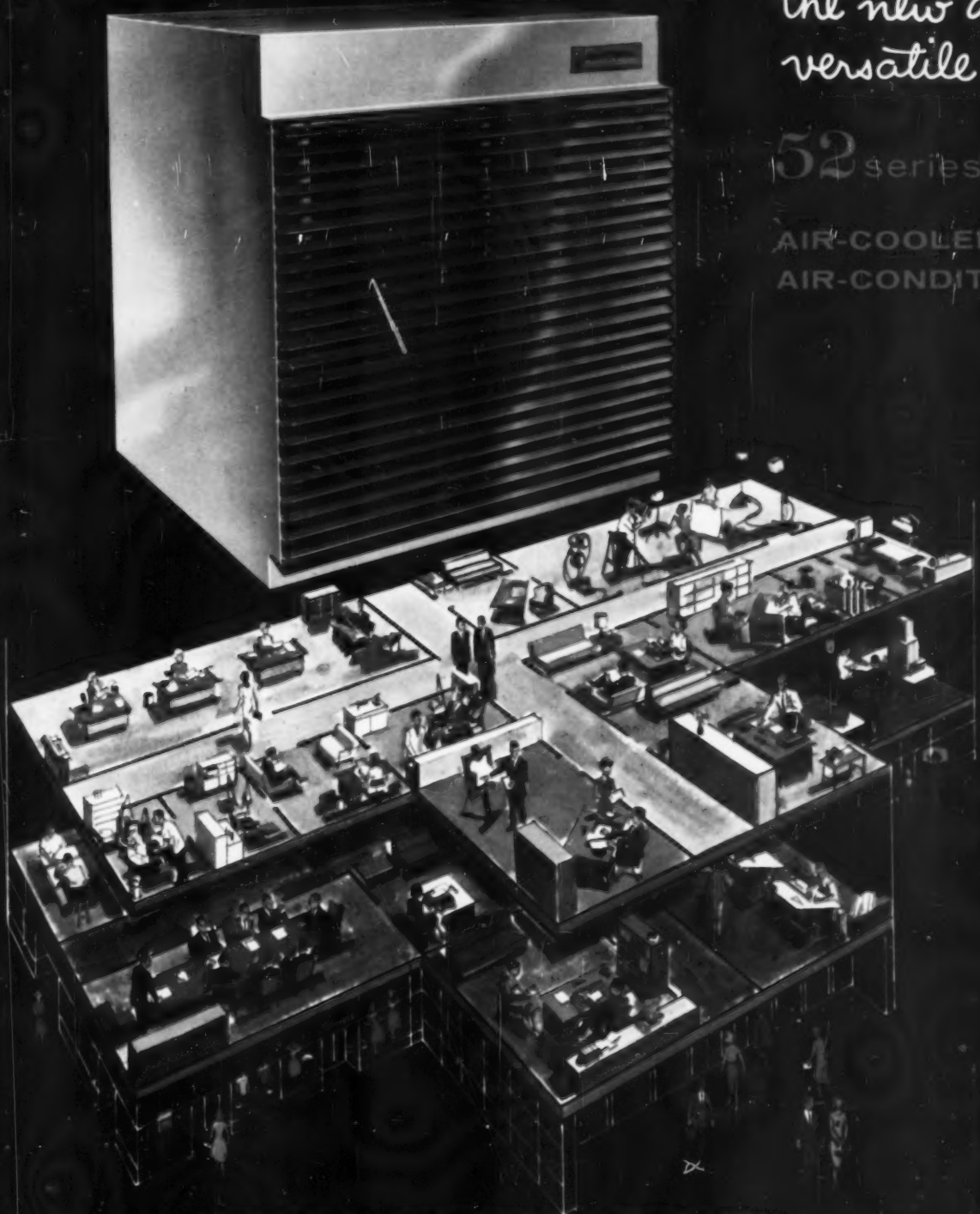
Automatically trips on decreasing instrument air signal either to vent is adjustable from 1 to 100 psig; repeatability ± 0.25 psi; can be reset after signal pressure is restored to approximately 10 percent above trip setting.

JANITROL

presents the new and versatile

52 series

AIR-COOLED
AIR-CONDITIONER

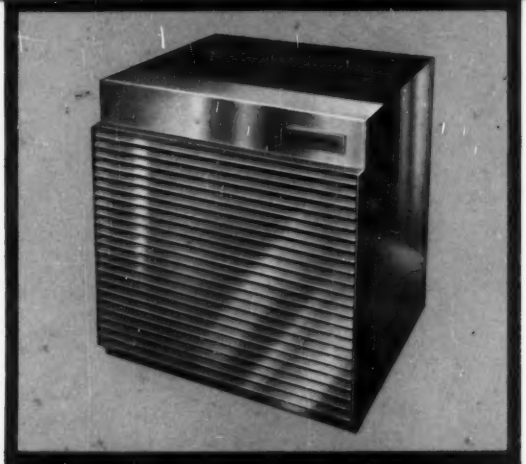


A PRACTICAL APPROACH TO ECONOMICAL,
HIGH EFFICIENCY COOLING FOR COMMERCIAL—
INDUSTRIAL BUILDINGS . . .

UNCHALLENGED COOLING PERFORMANCE...

in all-new JANITROL

52 SERIES CONDENSING UNITS



A COMPLETE LINE TO MEET ALL NEEDS... CAPACITIES FROM 22,200 TO 110,200 BTU/HR.

Outwardly beautiful and pleasing to the eye, inwardly rugged and powerful, new Janitrol 52 Series provides low-cost central cooling with matchless reliability and efficiency. Here are some of the many ways new Janitrol 52 Series condensing units are demonstrating their excellence . . .

In Performance . . . condensing coils have greater area to dissipate more heat and to provide higher efficiency. Operation with outside temperatures as high as 125°F.

In Styling . . . modern, simple and functional cabinet that will be in the best of taste in any landscape plan. Finished in beautiful, durable, weather-resistant, automotive-type enamel.

In Economy . . . powerful, top-mounted fan draws in quantities of cooler ground air over the condensing coil, which is shaded from the sun's heat by louvers.

In Quietness . . . compressor and fan are unusually quiet in operation. Cabinet is acoustically treated with a weatherproof, sound-absorbent material.

In Safety . . . upflow exhaust protects nearby plants from hot blasts . . . enclosing grilles safeguard pets and children.

In Service . . . all components are easily accessible. Service panels may be removed without affecting operation, to make checks while unit is in full operation.

A.R.I. CERTIFIED

Full A.R.I. certification is your assurance this equipment meets or exceeds standards of the Air Conditioning and Refrigeration Institute. A five-year written warranty backs up your choice.

JANITROL AIR-COOLED SUMMER AND YEAR 'ROUND COMFORT SYSTEMS TO MEET ALL NEEDS

Janitrol Win-Sum-Matic Year 'Round Systems

A complete central heating and cooling unit in a compact, smartly-styled cabinet smaller than most home refrigerators! Features air-cooled summer cooling, thrifty gas heat with Dura-Tube heating heart, guaranteed for 20 years! Exclusive "Season Selector" control allows changing from heat to cool (or vice versa) in seconds. No special tools or service call needed.

Janitrol Add-On Cooling System

With Janitrol Add-On Cooling, most any forced air furnace can be easily adapted to circulate cool, filtered air to every room in the home. The Janitrol evaporator coil is installed in furnace outlet duct and connected to the properly-sized 52 Series condensing unit. The existing furnace blower and duct system circulates the cooled, dehumidified air. Here's full central air conditioning at low, low cost!

New Janitrol J-Line Self-Contained Air Conditioners

The Janitrol J-Line models are an economical answer to cooling needs. In one compact unit are the blower, compressor and evaporator coils. Operation is remarkably quiet. May be used with ducts or as free discharge. Installs through walls in crawl space, in attic or other limited access locations.

Janitrol Schoolroom Cooling and Heating

Janitrol offers a self-contained room heating and ventilating system (with optional cooling) that features perimeter-type, draftless air distribution. Installation economies are noteworthy (savings up to 60% over large central systems). For new schools, additions and modernization.

WRITE TODAY!

for complete information on Janitrol heating and cooling systems for your business needs. Remember—architects and engineers can specify . . . and dealers can recommend and install *Janitrol* equipment with complete confidence it will provide the finest, most carefree performance possible.

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HEATING AND AIR CONDITIONING

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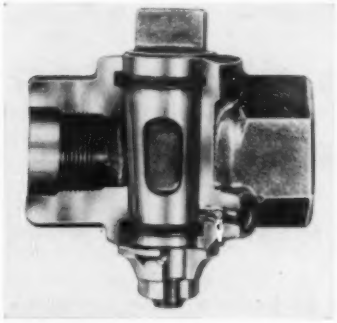
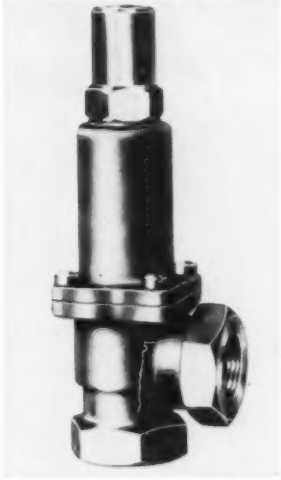
EQUIPMENT DEVELOPMENTS
Continued



Gas Stops . . .

. . . in working pressure of 500 psi—*Mueller Co.*, 512 *West Cerro Gordo, Decatur, Ill.*

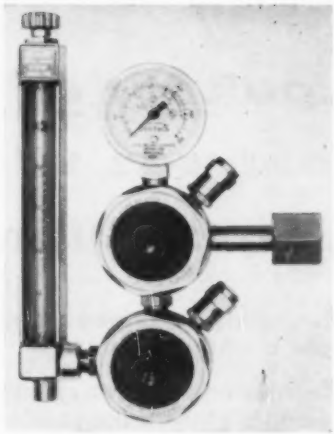
Made of ductile iron in ¾ and 1 in. sizes; features include individually ground body and key, tapered body ports, false ports to prevent grit and dust from depositing on sealing surface, ballcheck valve to prevent high pressure from blowing grease out of stop when filled with lubricant reservoirs.



Back Pressure Valves . . .

. . . featuring balanced piston design —*A. W. Cash Valve Mfg. Corp., Wabash at Morgan, Decatur, Ill.*

Have all bronze bodies, stainless steel springs and trim; available in ½ to 1¼ in. sizes with female inlets and outlets, relief pressure range from 5 psi to 600 psi with maximum temperature of 450 F; bulletin "3-9" available on request.



Flow Meter Regulators . . .

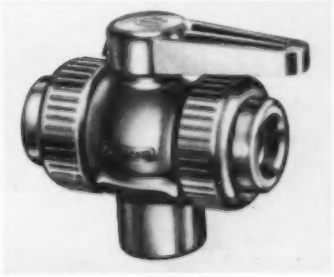
. . . for argon and helium—*Smith Welding Equipment Corp.*, 2633 *Fourth St., S. E., Minneapolis* 14, *Minn.*

Regulators are two-stage; first stage pressure setting is 100 psig, second is preset at 30 psig; flow range for argon meter is 60 scfh and 200 scfh for helium meter; regulator will hold pressure setting to 50-75 psi inlet pressure.

Pipe Joint Seal Nut . . .

. . . available in 9 sizes to fit pipe threads from ⅛ to 2 in.—*Weatherhead Co.*, 128 *W. Washington Blvd., Ft. Wayne, Ind.*

Eliminates leaks on all dry seal or standard pipe threads, according to manufacturer; fully descriptive bulletin "6170" available on request.



Plastic Ball Valve . . .

. . . designed for systems handling corrosive liquids—*Chemtrol*, 10872 *Stanford Ave., Lynwood, Calif.*

Valve available in various combinations of ½, ¾ and 1 in. port sizes; feeding to inlet, flow can be diverted

Install Insulation with

TUFF-BOND

Super-Strength Adhesives

TUFF-BOND #7
. . . fire-retardant adhesive for installing insulation

TUFF-BOND M-102-H
. . . economical duct liner adhesive

TUFF-BOND 21-C
. . . clear lap sealer and lap adhesive

TUFF-BOND 21-W
. . . white lap sealer and lap adhesive

TUFF-BOND #500
. . . exceptionally high-strength chemical-set adhesive with wide thermal range −100° F. to 350° F.

TUFF-BOND #1000
. . . high heat resistance for bedding and installing high temperature insulation

TUFF-BOND #12
. . . high pressure duct sealer

TUFF-BOND QUIK-SET
. . . neoprene-base, fast-setting adhesive. Recommended for installing metal and nylon hangers to smooth surfaces.

TUFF-BOND GENERAL PURPOSE IMPROVED
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Ask for descriptive literature and prices.

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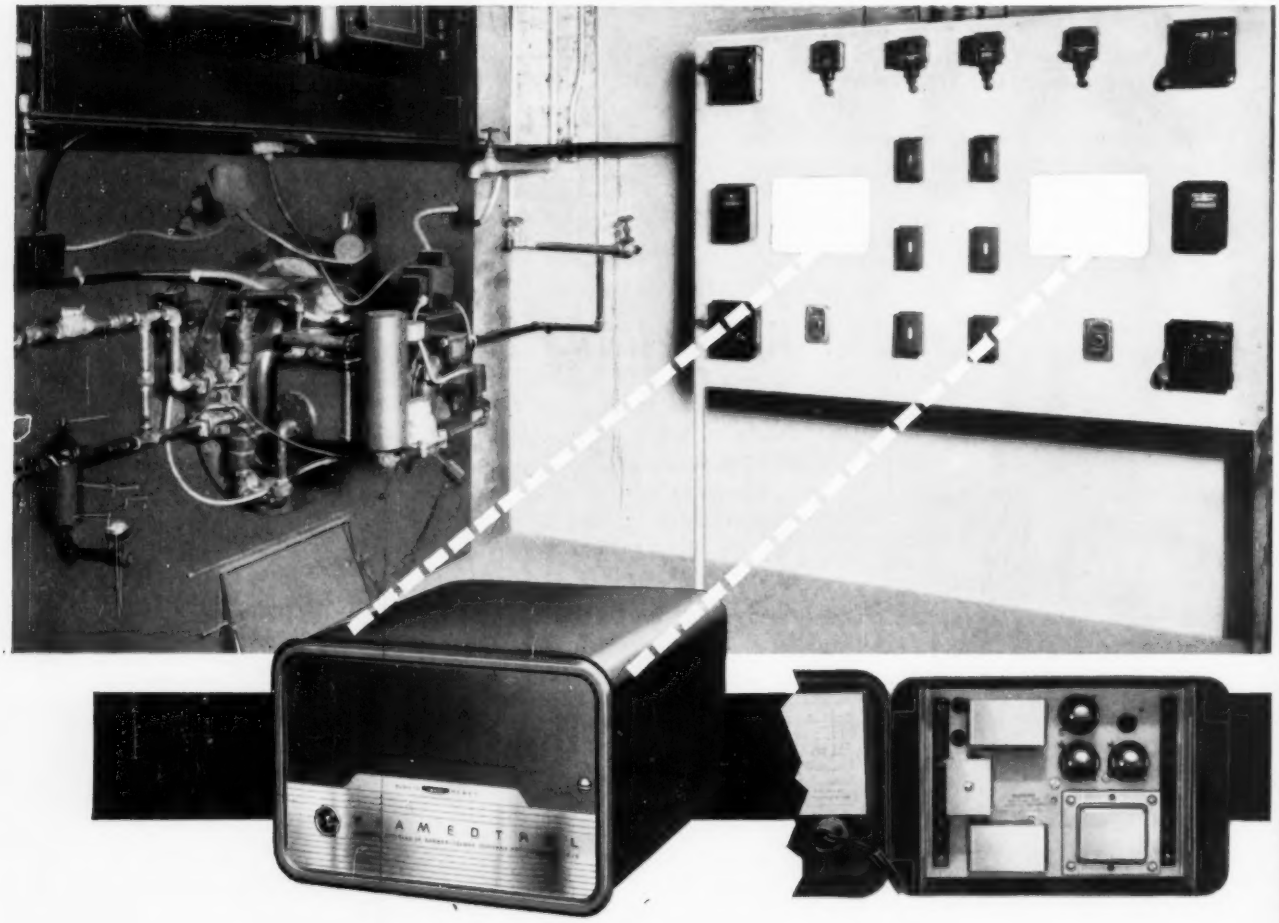
Wheelco Instruments

Look for all these features when choosing combustion safeguards

1. Ability to choose the best system for your needs from a complete line

2. Modern equipment designs to insure long trouble-free life, simple inspection and maintenance

3. Equipment backed up by a nationwide, thoroughly trained field organization



Pushbutton-start Flame-otrols, like the one shown here, are available with a Series 1470 Conductivity-Rectification system or a Series 1570 Infra-Red system.

Convenient external test points for checking circuits and voltages with conventional test instruments. Electronic tubes are standard types simplifying replacement.

write for literature describing Wheelco Flame-otrols.

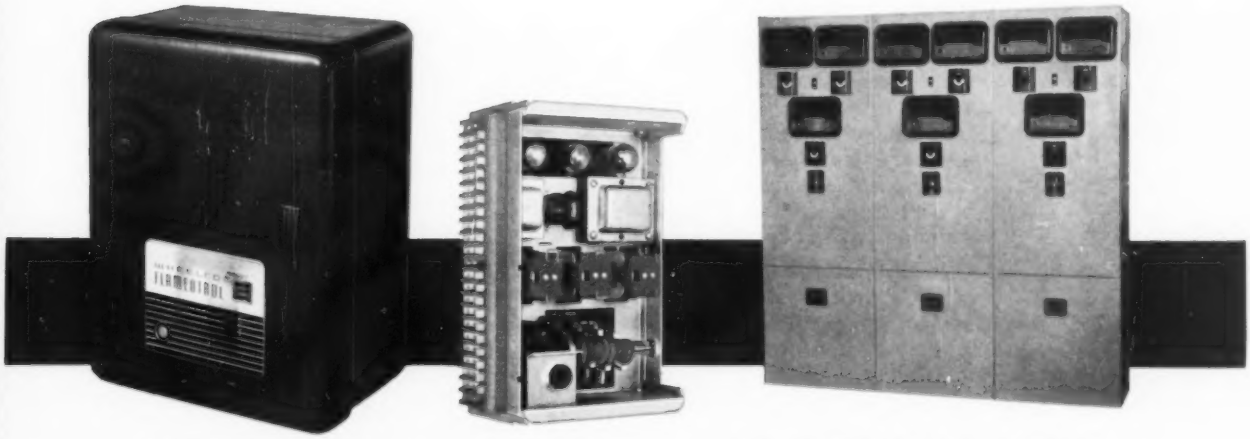
Unless your combustion safeguard system provides all these features you may be making an expensive and needless sacrifice. Wheelco Flame-otrols meet all these requirements whether the application be on a boiler, furnace, kiln, or dryer, and provide them at the cost of conventional equipment.

One Is Best — Wheelco offers two automatic operation and two pushbutton-start Flame-otrols to provide the exact system and the degree of control needed for a particular installation. Either Conductivity-Rectification "CR" systems or Infra-Red "IR" systems are used to monitor the flame. IR systems use a lead sulphide photoconductive cell as the sensing element, while CR systems use flame rods and emissive-type photo cells.

Easy Maintenance — With Wheelco's justly famous plug-in design, inspection and maintenance are easier and faster. The entire chassis may be removed for examination, adjustment, or repair. Standard electronic tubes are used throughout simplifying replacement from local stocks and cutting inventory needs. Wheelco's practical design permits Flame-otrols to be installed in every type of plant location by housing them in rugged, industrial-type steel cabinets provided with a gasketed, dust-tight, swing-out cover.

Control Centers Too — Custom-engineered installations that house a complete combustion safeguard system including Flame-otrols, pilot lights, alarms, etc., have long been a Wheelco specialty. These attractive centralized packages reduce installation costs and time, yet are provided with removable sections that offer flexibility for changing requirements.

Field Engineering Help — It pays to bring the Wheelco field engineer in on your planning when combustion safeguards are needed for a new or modernized installation. His experience plus the availability of a full line of instruments is your assurance of getting the system best suited to your needs. Wheelco field engineers are located in all principal cities, are as close to you as your telephone. This nationwide network, plus specialists in the home office, is always available to help you with your problems.



External and internal views of super-duty automatic Flame-otrols. Programing of these units includes purging, warm-up proving, pilot proving, low-fire stabilization, ignition timing and post-purging.

Custom-engineered Wheelco control centers can incorporate a wide variety of features. Either pushbutton-start or automatic Flame-otrols can be provided.

BARBER-COLMAN COMPANY

Dept. X, 1501 Rock Street, Rockford, Illinois, U.S.A.

BARBER-COLMAN of CANADA, Ltd., Dept. X, Toronto

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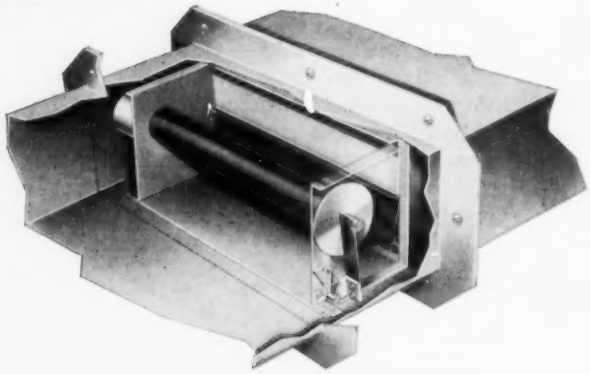
Uni-Flo

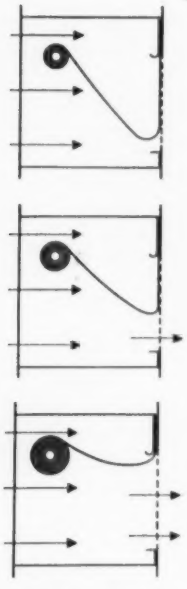
ENGINEERED AIR DISTRIBUTION

Self-operated control tames high-velocity air



Barber-Colman Model SCR constant volume regulator

...simplifies stabilization, maintains cfm delivery within ± 5%



Changes in static pressure cause the flexible diaphragm to move up or down automatically to control the open area of the discharge plate.

The Barber-Colman Model SCR constant volume regulator reduces high-velocity air to conventional velocities and delivers a constant cfm flow, regardless of pressure changes upstream.

This regulator is applicable anywhere in a duct system where there are changes in static pressure. No motor operator or other power source is required. The regulator is factory-set to meet job requirements but can be easily adjusted in the field should requirements change. Fully proved in service, this dependable control simplifies system design and stabilization.

Constant volume regulators can be used in low-velocity systems and provide self-balancing operation when installed in low-velocity branch ducts.

The Model SCR regulator also is available as an integral part of Barber-Colman complete double-duct control units which incorporate hot and cold air mixing valves actuated by a single motor operator.

New high-velocity manual — Ask for 52-page guide to design of high-velocity systems. Call your Barber-Colman air distribution field office or write.

BARBER-COLMAN COMPANY

Dept. X, 1101 Rock Street, Rockford, Illinois

EQUIPMENT DEVELOPMENTS

Continued

in either of two directions or complete shut-off effected; compatible with all types of piping.

Valve Operator . . .

. . . employing large volume air chamber on one side of operator diaphragm—*George W. Dahl Co., Inc., 86 Tupelo St., Bristol, R. I.*

Chamber is pneumatically loaded at any desired pressure and sealed by check valve; models available in either pressed steel or cast aluminum operator cases.

Pressure Probe . . .

. . . for measuring total pressure variations inside fluid flow machinery—*United Sensor & Control Corp., Box 127, Glastonbury, Conn.*

B.F.Goodrich

Know what to make of this?

B.F.Goodrich does . . . because it's their cellular material in one of the thousands of forms and shapes they make for the air conditioning and refrigeration industries. In this case, it's a component for a refrigerated cabinet.

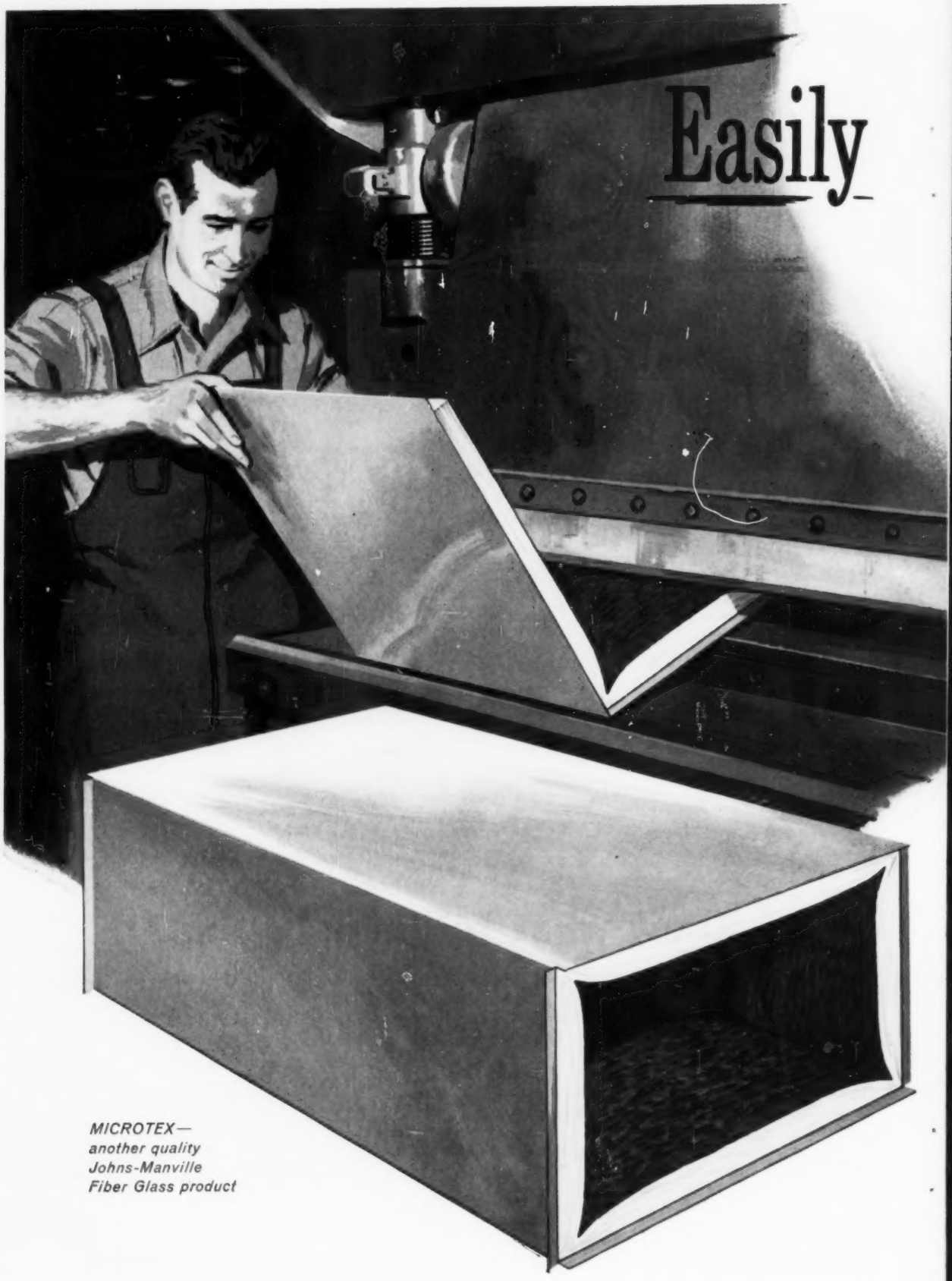
In sponge rubber or cellular plastic, B.F.Goodrich industrial cellular materials are excellent for sealing, gasketing, insulating and vibration damping – under even the most trying conditions.

So get the advantage of the experience that has put B.F.Goodrich cellular materials into The Sheraton Hotel, Philadelphia; The Conrad Hilton, Chicago; The Corning Glass Building, New York and many other New York office buildings. Write The B.F.Goodrich Company, 581 Derby Place, Shelton, Connecticut.

CELL-TITE INSULATION TUBING

Cell-Tite tubing is made of tough, flexible rubber with uniform non-connecting cell structure. Especially efficient and convenient for pipe insulation, it will not absorb moisture nor support combustion. Insulation value is excellent. Lengths up to fifty feet make it easy and simple to install.

B.F.Goodrich ***industrial cellular materials***



MICROTEX—
another quality
Johns-Manville
Fiber Glass product

prefabricated in the shop

J-M Microtex® fiber glass duct liner simplifies fabrication to keep your costs low

More and more, J-M Microtex is the material contractors like to see on a specification. For few materials are so readily installed . . . with savings that are measurable both in the shop and on the job.

In the shop, Microtex is quickly, easily fastened to sheet metal to form insulated sections that arrive at the job site ready to go up . . . requiring no special techniques or installation procedures.

A semi-rigid fiber glass blanket, Microtex has countless microscopic air pockets that trap the sound of motors, fans or other disturbing noises. Comfort is increased, too, because temperatures of the cooled or heated air can be more evenly controlled during distribution. With Microtex, there's no vapor barrier needed . . . it's provided by the sheet metal. Also with Microtex you have another advantage—black vinyl coating that resists air erosion . . . eliminates need of painting inside of ducts in back of grills.

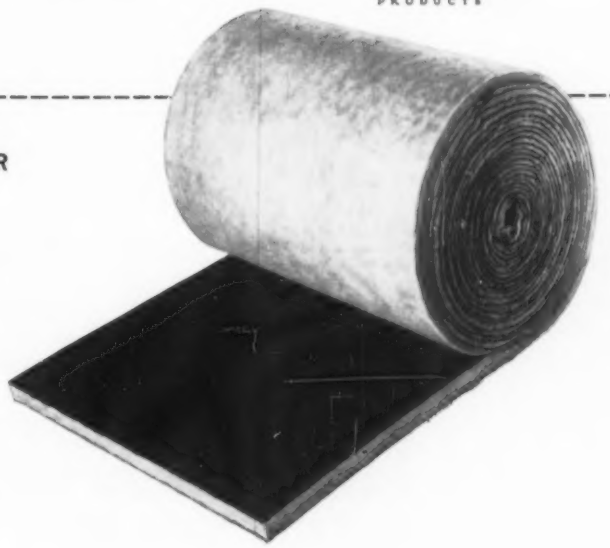
For installation data on Microtex fiber glass duct liner, write to Johns-Manville, Box 14, New York 16, N.Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS

5 REASONS CONTRACTOR COSTS ARE LOWER WITH JOHNS-MANVILLE MICROTEX

- **EASY TO CUT AND FIT.** Regular shop methods, skills and tools speed fabrication.
- **RESILIENT.** Can be formed with the metal in the brake.
- **STRONG.** Holds up during shop handling. Won't pull apart. Less waste.
- **PLEASANT TO HANDLE.** Workmen like the texture of Microtex.
- **LIGHTWEIGHT MATERIAL.** Adds only ounces to weight of sections.

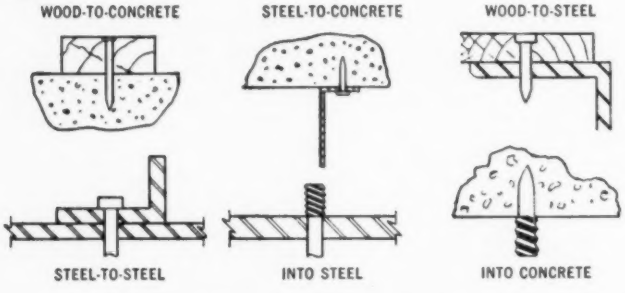


ONLY RAMSET

"covers all the bases in powder-actuated fastening"

This statement has been made by hundreds of contractors, architects, electricians, plumbers, maintenance men, supervisors, foremen and others over the past ten years! Whatever the job, if it involves fastening into concrete or steel Ramset can do it more easily, efficiently, and with a lower in-place fastener cost.

Threaded studs, drive pins, eye pins—over 100 specialized fasteners team with ten types of powder charges to assure you of just the right holding power for each job. It will pay you to get more details. Your Ramset dealer is listed in the Yellow Pages under tools . . . call him today!



In addition to powder-actuated fastening, the versatile Ramset System includes Shure-Set® hammer-in tools for light fastening, and Ringblaster® heavy-duty kiln gun.

Ramset® Fastening System

WINCHESTER-WESTERN DIV. • OLIN MATHEISON CHEMICAL CORPORATION
291-L WINCHESTER AVENUE • NEW HAVEN 4, CONNECTICUT

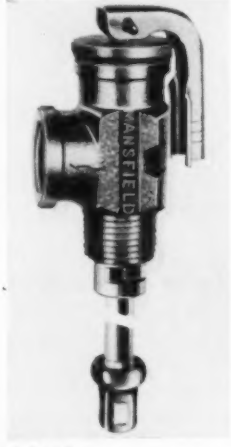
EQUIPMENT DEVELOPMENTS
Continued

Can be inserted through ⅛ in. diam hole; has measuring head 1/16 in. diam by 0.10 in. long; will measure pressure up to yaw or pitch angles of 45 deg from axis of head.

Needle Valves . . .

. . . in sizes from ⅛ to ½ in.—*Whitey Research Tool Co., 1150 55th St., Oakland, Calif.*

Furnished in stainless steel, other alloys; recommended by manufacturer for applications involving processing of viscous and volatile liquids, gases at high and low temperatures, pressure vacuum, and corrosive conditions.



Relief Valve . . .

. . . in either ½ or ¾ in. male inlets—*Mansfield Sanitary, Inc., Perrysville, O.*

5 OUTSTANDING EXCLUSIVE ADVANTAGES IN THE REVOLUTIONARY NEW

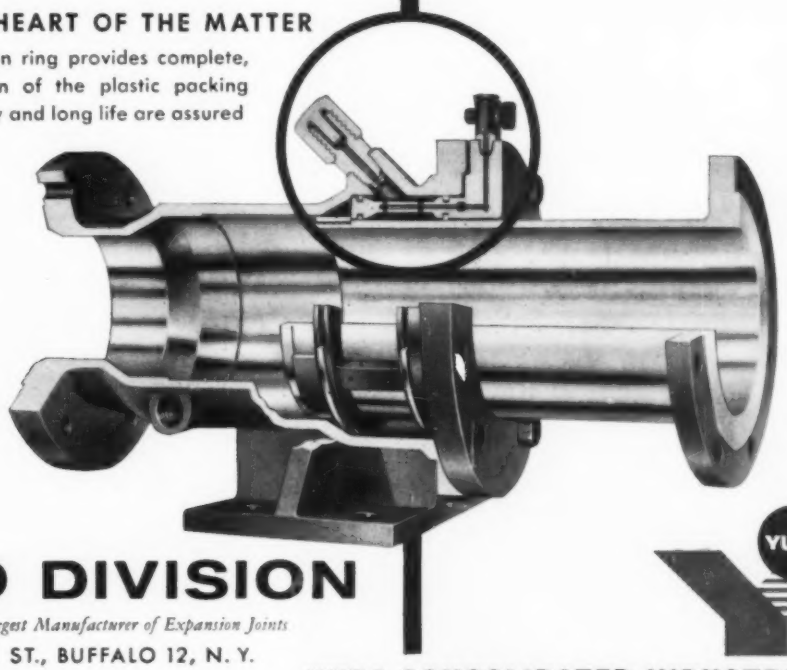
ADSCO RAM-PAK EXPANSION JOINTS

The 5 advantages are: One-point lubrication; 2) *complete* and *uniform* lubrication of the packing assured by the lubricant dispersion ring; 3) removable packing chamber permits replacement of packing without removing expansion joints from the line; 4) rugged outward limit stop is provided by internal guide and, in addition, an outer guide is provided; 5) support base conforms in all respects to A. S. A. standards.

RAM-PAK was designed by ADSCO, the oldest and largest manufacturer of expansion joints in the world. ADSCO invented the first expansion joint in 1877, since then has given the heating industry many great advancements, including the famous Piston-Ring Expansion Joint. Now, in the RAM-PAK, ADSCO offers engineers a high performance, economical, entirely new expansion joint which is unbelievably ingenious in construction. Write for complete information.

HERE'S THE HEART OF THE MATTER

Lubricant dispersion ring provides complete, uniform lubrication of the plastic packing material. Resiliency and long life are assured



ADSCO DIVISION

World's Oldest and Largest Manufacturer of Expansion Joints

20 MILBURN ST., BUFFALO 12, N. Y.

YUBA

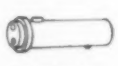
YUBA CONSOLIDATED INDUSTRIES, INC.

Plants and Sales Offices

Other Adsco Products for the Heating Industry

Corruflex Packless Expansion Joints

Alignment Guides

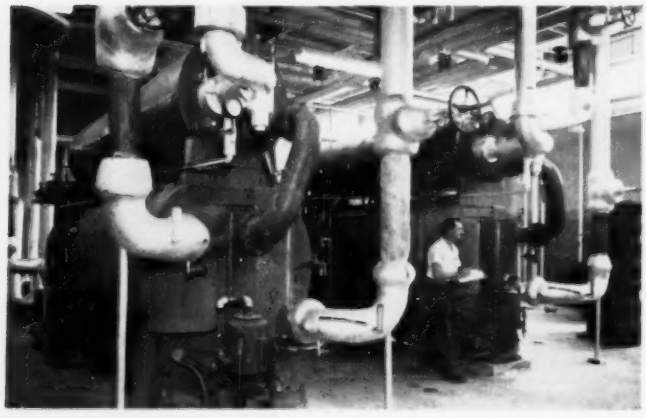


Instantaneous Heaters

Storage Water Heaters

NO SUMMERTIME SLUMP With gas as the boiler fuel and York machines, the switch to summer cooling was no problem. Operating costs are low, too, thanks to Gas.

LATEST IN COOLING Gas operated York machines feature the use of tap water as refrigerant and lithium bromide as absorbent, one of the most efficient, practical refrigeration cycles developed so far. Machines start and stop automatically.



THE UTMOST IN FLEXIBILITY The units are cross-connected so that each operates independently if necessary.

MAINTENANCE COSTS TO DATE—ZERO! The Allen Company uses two York machines—a 230-ton unit serving 45,000 sq. ft. of office and cafeteria space, a 170-ton unit for process water cooling. Three small pumps and motors are the only moving parts in the entire system.

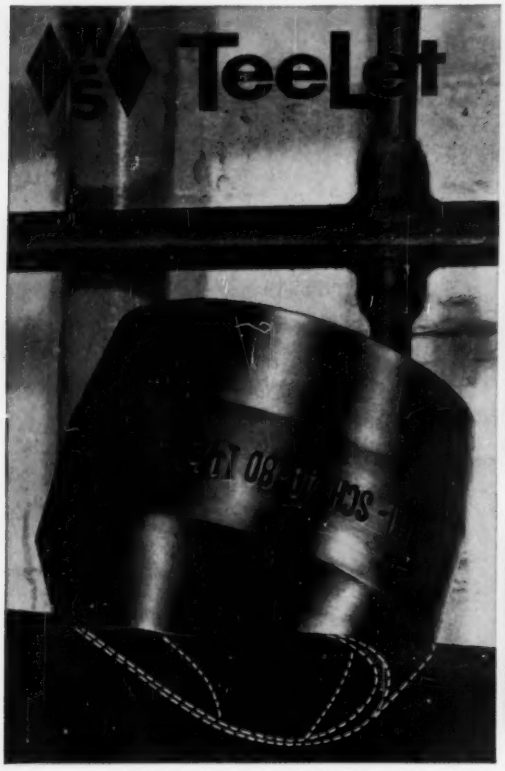
"with **YORK GAS** *air conditioning our boilers keep us cool all summer"*

"With our boilers sized for a winter load, we were naturally oversized for the summer months. But York's gas-operated Lithium Bromide absorption water chillers permit us to make efficient use of part of this steam capacity to cool," says Mr. M. J. Mather, President of the Allen Manufacturing Company, makers of hex-socket screws.

The York Lithium Bromide system eliminates the need for huge compressors found in other types of cooling equipment . . . which brings down the original cost considerably. And with gas the boiler fuel, you make year-round use of an otherwise wasted source of power *at rock bottom costs.* In addition, York machines are noiseless, lightweight, compact—easy to install and readily adaptable to almost any plant layout.

Find out how your present heating system can pay off for you all year 'round with gas-operated York automatic water chilling units. Call your local gas company or write to the York Corporation, Subsidiary of Borg-Warner Corporation, York, Pennsylvania. *American Gas Association.*

FOR ⅜ TO 1½ INCH BRANCH CONNECTIONS



MARK

CUT

WELD

NEW W-S TeeLet SLASHES TEE COSTS 50% OR MORE!

The new W-S TeeLet replaces conventional Tees of cast or malleable iron, welded or forged steel . . . requires fewer stock sizes. Available in sizes from ⅛ to 1½" IPS, TeeLets are fully machined from forging quality solid steel bars and adapt to run-pipe sizes to 36". They require no additional joint strength calculations for any ASTM A-53 or A-106 Grade B run-pipe of Schedule 40 or 80.

What about cost? A size-by-size comparison with conventional Tees shows TeeLets average less than 50 per cent of the cost you now pay. A W-S TeeLet, with screwed, socket-weld or butt-weld ends, requires no shaping, fitting, beveling or extra alignment. You can connect to the run-pipe at any point. Short heights mean easy inspection of the attachment weld or back-weld, if desired.

A W-S TeeLet costs less to buy, less to install than anything you can buy or make. For complete information, prices, and names of distributors, write: *Forge and Fittings Division, H. K. Porter Company, Inc., Box 95, Roselle, N. J.*

FORGE AND PORTER FITTINGS DIVISION

H.K. PORTER COMPANY, INC.

PORTER SERVES INDUSTRY: with Rubber and Friction Products—THERMOID DIVISION; Electrical Equipment—DELTA-STAR ELECTRIC DIVISION, NATIONAL ELECTRIC DIVISION; Specialty Alloys—RIVERSIDE-ALLOY METAL DIVISION; Refractories—REFRACTORIES DIVISION; Electric Furnace Steel—CONNORS STEEL DIVISION, VULCAN-KIDD STEEL DIVISION; Fabricated Products—DISSTON DIVISION, FORGE AND FITTINGS DIVISION, LESCHEN WIRE ROPE DIVISION, MOULDINGS DIVISION, H. K. PORTER COMPANY de MEXICO, S. A.; and in Canada, Refractories, "Disston" Tools, "Federal" Wires and Cables, "Nepcoduct" Systems—H. K. PORTER COMPANY (CANADA) LTD.

EQUIPMENT DEVELOPMENTS
Continued

Both models furnished with 6 in. extension tubes which provide contact with hottest water in tanks; valves close automatically after 10 F temperature drop; constructed with brass bodies; have Btu rating of 150,000; can be adjusted to relieve water at any pressure between 50 and 200 psi; descriptive bulletin "LL-9826" available on request.

Temperature Regulator . . .

. . . suitable for steam pressures up to 150 psi—*Lawler Automatic Controls, Inc., 453 N. MacQuesten Pkwy., Mt. Vernon, N. Y.*

Available in sizes ½ through 2 in. steam pressure rating up to 150 psi in bronze body with union ends; all valve trim parts of stainless steel.

Roof Ventilators . . .

. . . for industrial and commercial use —*Romla Co., 13101 S. Main St., Los Angeles 61, Calif.*

Available with spark-proof aluminum alloy high-speed propeller fan blade for industrial processing and drying systems; wide blade, slow-speed steel propellers available where air must be exhausted against lower resistance.

Water Chiller . . .

. . . in 12 basic models from 15 to 120 tons—*Governair Corp., 4846 N. Sewell, Oklahoma City, Okla.*

Completely self-contained with all components, including evaporative condenser in one cabinet.

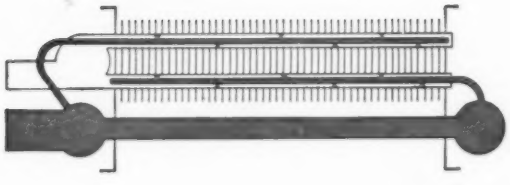
Air Conditioning Controls

. . . engineered to handle variety of commercial applications — *Ranco, Inc., 601 W. Fifth Ave., Columbus 1, O.*

Controls handle one, two and three-phase overload protected motors of ½ through 5 hp capacity; electrical ratings for single-phase connections and 120 v a-c are at 12 amps full load, 72 amps locked rotor and 24 amps full load, 144 amps locked rotor.

Don't Monkey with the Controls

Evntemp Coils Prevent Uneven Heating



Call your nearest Marlo representative, or write us for bulletin and complete information

Only EVNTEMP coils give you these proven benefits for better heating

- √ **Uniform Leaving Air Temperature from 100% to 10% Capacity**
- √ **Controllable Modulating Performance**
- √ **Precise Steam Distribution**
- √ **Non-Internal Air Binding**
- √ **Freeze-Up Protection**

Marlo coil co.

SAINT LOUIS 11, MISSOURI

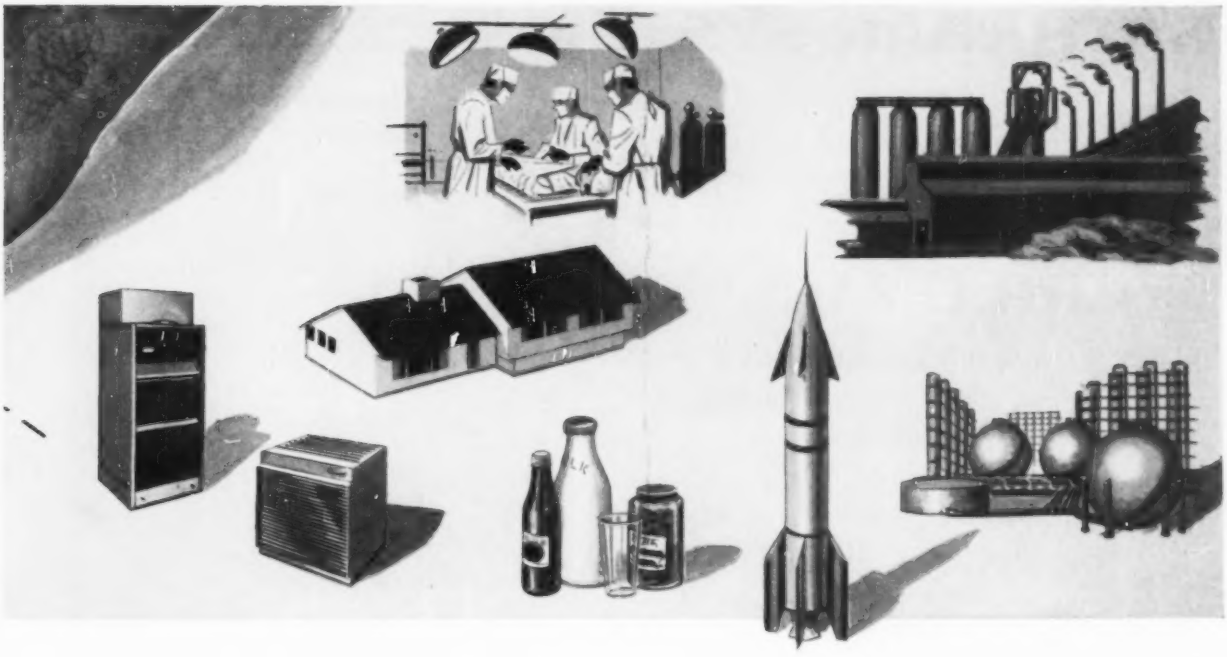
Quality Air Conditioning and Heat Transfer Equipment Since 1925

M-R MIDLAND-ROSS CORP.

MIDLAND—

Executive Offices: 55 Public Square • Cleveland 1, Ohio

DIVERSIFIED TO SERVE NEARLY ALL INDUSTRIES . .



To serve even more industries even better...

MIDLAND-ROSS ADDS SURFACE, JANITROL, and WEBSTER ENGINEERING

On November 9, Midland-Ross Corporation acquired for cash the Surface Combustion Corporation, its Janitrol Divisions, and subsidiaries, including Webster Engineering Company of Tulsa.

Midland-Ross's purchase of Surface is another step in its program of planned expansion into new products, services and markets. Surface, Janitrol, and Webster fit this pattern ideally. No changes in management or operations are contemplated for the new acquisitions.

The addition of Surface, Janitrol, and Webster Engineering will greatly expand the number of industries which Midland-Ross serves. Janitrol is a famous name in residential, commercial, and industrial comfort heating and air conditioning, and aircraft heating . . . Webster is a famous name in oil and gas burners and controls for industrial and refinery heating and process-steam generation . . . Surface is famous for heat-treat furnaces, soaking pits, and heating equipment of many types for the metal-producing, metal-fabricating, glass, ceramics, and other industries . . . Surface "Kathabar" equipment is well-known where humidity and bacteriological cleanliness of air must be closely controlled.

Assets of the enlarged Midland-Ross organization are now over $70,000,000. Employees now total 5,800. Fourteen plants are located in six states and Canada. Sales in 1960 are forecast at more than $120,000,000.

For a copy of "Quick Facts about Midland-Ross, Surface, and Janitrol," write to:

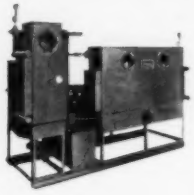
—ROSS CORPORATION

Automotive frames; process and production equipment for the paper, textile, rubber, plastics, and foil industries; pneumatic controls and compressors for mobile equipment; power brakes; die castings; metal-decorating, laminating and painting equipment; steel-mill equipment and heat treat furnaces; industrial ovens; humidity-control equipment; residential, commercial and industrial heating and air-conditioning equipment; aircraft, missile, and ground-support heaters, heat exchangers, and controls.

. . INTEGRATED TO SERVE THEM BETTER

KATHABAR® SYSTEMS

Give these advantages to specifying engineers:



STERILE AIR

Now you can design spaces to maintain air sterility as scientifically as temperature and humidity. Only Kathabar enables you to deliver air at 5 micro-organisms per 10 cu. ft. or less, continuously.

DRY SURFACES

Permanently stop condensation on walls, floors, products. Dry up exposed water (bacteria breeding ground) no matter what your dry bulb. Results proved (you check) almost anywhere: foods... chemicals...waterworks... cargo ships...even caves! Name your required conditions (grains/pound and dry bulb) for process, storage, testing: Kathabar systems deliver.

GET FACTS

SURFACE COMBUSTION CORPORATION
2384 Dorr Street, Toledo 1, Ohio

Send facts on Kathabar systems for following application:

.....

.....

name & title.....
company.....
street.....
city.....*zone*.....*state*.....

Surface

59-1E

EQUIPMENT DEVELOPMENTS
Continued

Infrared Heater . . .

. . .designed to be mounted side by side, or end to end—*N.J. Thermex Co., Inc., 533 Bergen St., Harrison, N.J.*

Operates in spectrum of intermediate infrared radiant wave length of 1.7 to 3 microns with peak of 2.2 microns.

Elbow Fans . . .

. . .capacities from 600 to 32,000 cfm at static pressures up to 2 in. water gage or more—*L. J. Wing Co., Div. Aero Supply Mfg. Co., Inc., 140 Vreeland Mills Rd., Linden, N.J.*

Fans have adjustable-pitch V-belt to permit field adjustment of capacity to suit actual or changed conditions; standard fans handle air up to 750 F.

Pipe Pushers . . .

. . .in three sizes capable of gripping up to 4 in. ID pipe—*Mercury Hydraulics, 1632-46 Wazee St., Denver, Colo.*

Features thrusts up to 110,000 lb; shorter thrust, according to manufacturer, serves to increase speed; contains non-crushing, self-gripping and releasing pipe clevis.

Portable Heater . . .

. . .with 320,000 Btu per hr capacity —*Master Vibrator Co., 1752 Stanley Ave., Dayton 1, O.*

Features thermostatic control and automatic fan cut-off control; no vent necessary; heater plugs into 115 v a-c outlet and burns on kerosene.

Diesel Pumps . . .

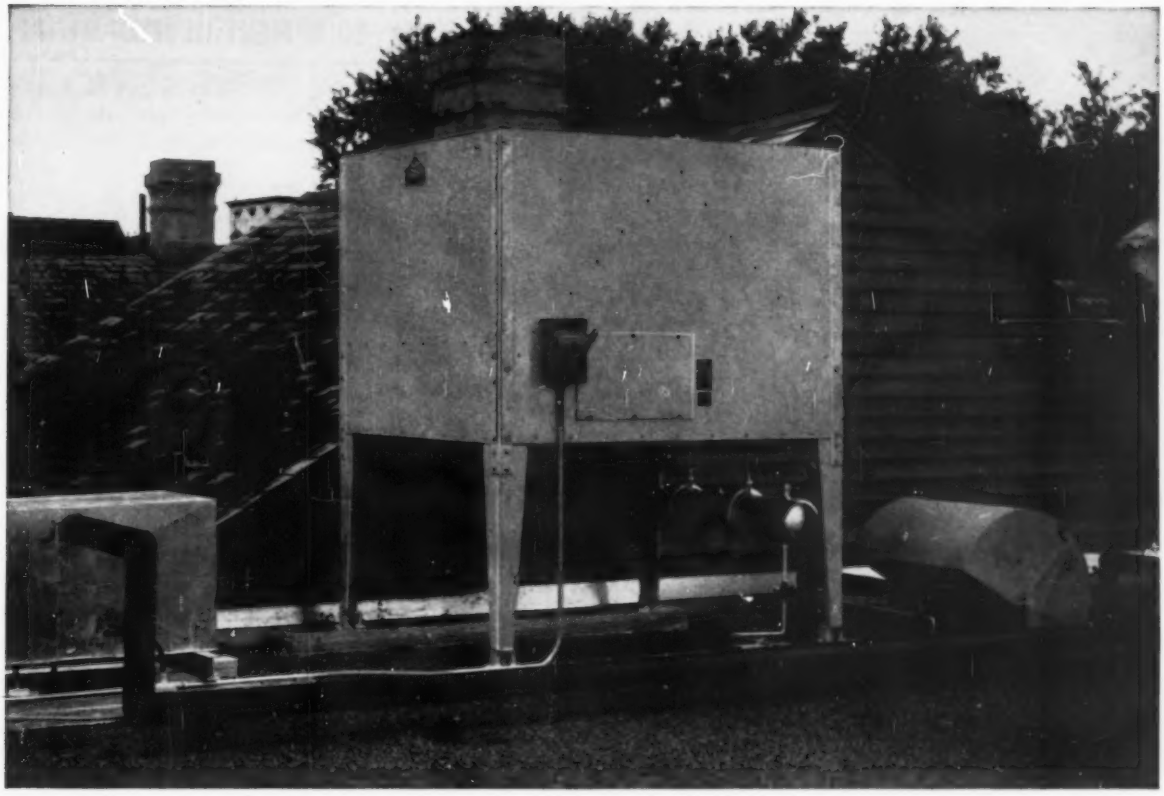
. . .available in 40 to 1600 gpm capacities—*Carver Pump Co., 1460 Hershey Ave., Muscatine, Iowa.*

Line of pumps are self-priming or non-self-priming for various applications.

Nylon Pipe Fittings . . .

. . .available in sizes up to 4 in.— *Plastiline, Inc., 2 Intervale St., White Plains, N. Y.*

Designed for applications in jet



Marley DRICOOLER®

AIR COOLED REFRIGERANT CONDENSER

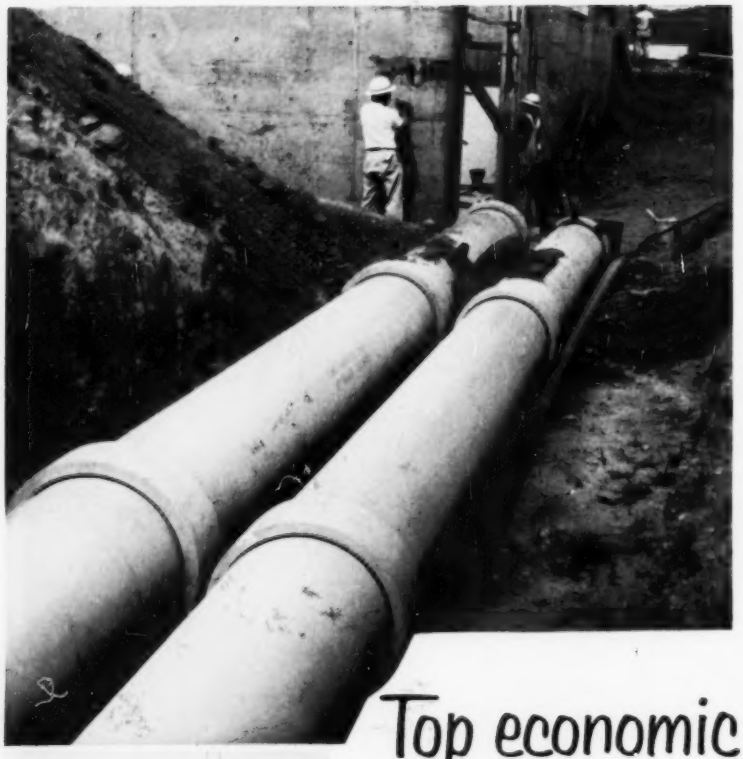
gives a new look in the "OLD QUARTER"

Even amidst the old-world charm of New Orleans' French Quarter, chain operators are quick to adopt change that results in improved efficiency and increased profits. That's why a chain store in the Vieux Carré was among the first to install Marley's new DriCooler to handle the cooling requirements for its air conditioning and refrigeration systems.

In Marley's complete new series of air cooled refrigerant condensers, you'll find *more* of everything you want—performance, durability, economy. DriCoolers are conservatively rated to insure full-capability performance, built to insure lasting performance. Dependability and durability are apparent in the heavy-duty, industrial-type mechanical equipment, and in extra-rugged structurals and casings that are hot-dip galvanized for maximum corrosion resistance. Design innovations have significantly lessened maintenance and refrigerant costs. Operational noise has been minimized.

You're on solid ground when you specify DriCoolers, for they are backed by Marley's world of experience in air cooled heat exchange, and by the company's single-responsibility guarantee. For complete information on the 9 models available for all-season service, in capacities from 15-100 tons nominal, call your nearby Marley engineer or write today.

THE MARLEY COMPANY MARLEY KANSAS CITY, MISSOURI



Top economic life!...

Transite Pipe is strong, lightweight, easily handled . . . only larger diameters need handling equipment.

Transite Pipe is priced, designed and formulated to be today's best buy in factory water mains

When it comes to pressure pipe—you can pay more than you would for Transite®. Or you can pay less. But no other material gives you more than Transite in *economic life!* For Transite's every advantage—whether of price, installation or performance—contributes to maximum, long-term economy.

First, there's Transite's low cost. Then, there's its installation economy! Lightweight, easily handled, it needs fewer men to install it. Installation is made still faster, *surer* with Transite's Ring-Tite® Coupling that provides a tight, lasting seal.

Once in operation, savings continue. Transite's smooth interior stays smooth—keeps pumping costs low, assures full water flow for the life of the pipeline. Made of asbestos-cement, Transite keeps maintenance to the barest minimum . . . it can't rust, is highly resistant to both corrosion and electrolytic action. Write for Pressure Pipe folder TR-160. Ask too about Transite Pipe for other plant services. Write Johns-Manville, Box 14-FA, New York 16, N.Y.

The Ring-Tite Coupling speeds and simplifies installation . . . assures lasting protection against leakage.

JOHNS-MANVILLE JM PRODUCTS

EQUIPMENT DEVELOPMENTS
Continued

well installations, industrial piping, air conditioning, and ice skating rinks.

Cooling Tower . . .

. . . made in weatherized cabinets—*Halstead & Mitchell, Zelienople, Pa.*

Overall height is under 9 ft; has air inlets at both ends and low speed, large diameter fans; is vertical discharge type at capacity of 150 tons.

Air Cooled Condenser . . .

. . . which utilizes rejected condenser heat for heating and ventilating—*McQuay, Inc.*, 1600 *Broadway, N.E., Minneapolis, Minn.*

Available in 7 models and 8 unit arrangements with capacities from 10 to 50 tons; can be ceiling, platform or floor mounted.

Air Hose . . .

. . . made from flexible polyamide formulation—*Synflex Products Div., Samuel Moore & Co., Mantua, O.*

Constructed with micro-finished bore and full flow, non-flared fittings; available in working length of 20 ft at pressures up to 200 psi.

PVC Blowers . . .

. . . designed for use in laboratories where corrosive fumes or moisture are a problem—*Industrial Plastic Fabricators, Inc., Endicott St., Norwood, Mass.*

Available in three models with 1/3, 3/4, 1 hp motors in capacities from 399 to 2000 cfm; designed to withstand temperatures up to 140 F.

Portable Heater . . .

. . . designed to heat buildings under construction—*John Wood Co., Conshohocken, Pa.*

Requires no vent and is equipped with fold back stainless steel combustion chamber; can produce 120,000 Btu per hr; has heated air output of 450 cfm; 1/6 hp motors takes 115 v of 60 cycle a-c current.

ANOTHER NEW LESLIE PRODUCT

ADJUSTABLE PROPORTIONAL BAND Floatless LIQUID LEVEL CONTROL

...with adjustable level ranges up to 0-200"

Here is a new differential pressure-type liquid level control pilot that combines the wide adjustable level ranges in the table shown below with a 2-20" or 7-25" adjustable proportional band.

ADJUSTABLE LEVEL RANGE — INCHES	ADJUSTABLE PROPORTIONAL BAND (INCHES, H_2O)	CONTROL PILOT TYPE
0-40 or 0-87	2-20	LAP
0-30 or 0-91	2-20	LABP
0-200	7-25	LAUP

Maximum Static Pressure — 300 psi

One Knob — Easy Adjustment

A single knob adjustment quickly sets the proportional band where you want it, even while the system is in operation. The liquid level is maintained constantly within that band until you re-set the control pilot for new conditions.

Applications

Leslie-Level-Matic Control Pilots are used in either open or pressurized vessels to control the level of virtually any liquid including water, gasoline, oil and chemical solutions. The new control pilot is particularly useful to maintain constant levels where there are high flow rates through vessels with small cross sectional areas.

Float Cages Eliminated

There are no floats or cages needed for Leslie-Level-Matic Control Pilots, and no torque tube seals, stuffing boxes, or thermohydraulic systems. All of the primary control elements are in one place and may be installed with a fraction of the effort and cost required for displacement-type controllers.

Vibration-Proof, Dependable

All of the dependability factors for which Leslie products are so well-known are incorporated in this new control pilot, as well. Rugged, accurate, stable — it is unaffected by normal vibration or turbulence.

More Information

Send for Engineering Data Sheet describing this new Control Pilot and outlining its principle of operation.

Knob and indicator-type proportional band adjustment permits setting in a matter of seconds.

LESLIE REGULATORS and CONTROLLERS

674

LESLIE CO., 437F Grant Avenue, Lyndhurst, New Jersey

Here's why any powder-actuated tool works better with Remington Loads and Studs

Exclusive "Kleanbore" Priming

22 caliber Power Load (twice actual size)

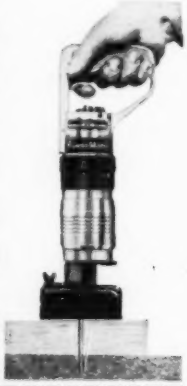
Scientifically graded Remington Power Loads offer precise, uniform charges . . . have strong, non-rusting brass cases. Exclusive "Kleanbore" priming mixture protects bore of tool because it does not cause rust or corrosion. No need to clean barrel after every job! These quality Power Loads are subjected to multiple inspection during manufacture, are backed by Remington—a name well known to American sportsmen. No matter what powder-actuated tool you use, it will work *better* with Remington Power Loads!

Green "Power-Guide"

¼" S-25 Stud (twice actual size)

Uniform performance and penetration are assured with precision-made ¼" and ⅛" diameter Remington Studs. These high-strength studs are made with special molybdenum steel. Specify Remington Studs with exclusive green "Power-Guide" heads . . . for uniform performance and straight-driving penetration. Over 60 "job-rated" Studs to choose from—your assurance of a Remington "Power-Guide" Stud to fit every fastening application.

Remington know-how insures the quality of its Studs and Power Loads. No other company can offer the background of experience gained through the manufacture of billions of these units. When you order studs and loads, you'll get better performance if you specify Remington—maker of the most versatile fastening tool ever designed (right). We'll gladly send valuable free booklets about Remington Power Loads, Studs and fastening tools. Mail the coupon today!



Remington Model 455A Stud Driver

Remington

DU PONT

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Remington Arms Company, Inc., Bridgeport 2, Conn.
IN CANADA: Remington Arms of Canada Limited, 36 Queen Elizabeth Blvd., Toronto 18, Ont.

G-12

Remington Arms Company, Inc., Bridgeport 2, Conn.
Please send—without obligation—catalogs on Remington Contractor & Industrial Tools checked:

☐Stud Drivers ☐Air Tools ☐Chain Saws
☐Concrete Vibrators ☐Flexible Shaft Machines

Name_____ Position_____

Company_____

Address_____

City_____ Zone___ State_____

EQUIPMENT DEVELOPMENTS *Continued*

Pressure Reducing Valve

. . . for application to installations where street main pressure is less than setting of pressure relief valve —*Watts Regulator Co.*, 10 *Embankment Rd., Lawrence, Mass.*

Prevents dripping from heater relief valve which would relieve due to thermal expansion pressure; available in ½, ¾, 1 in. sizes.

Pipe Thread Tape . . .

. . . to provide threaded pipe joints which are leakproof—*Tube Turns Plastics, Inc.*, 2929 *Magazine St., Louisville* 11, *Ky.*

Suitable for unplasticized polyvinyl chloride, stainless steel, aluminum and other corrosion-resistant piping.

A-C-D-C Welder . . .

. . . which is gasoline driven for work where normal power is not available —*Hobart Bros. Co., Hobart Square, Troy* 1, *O.*

Unit is rated at 250 amp, 30 v for DC welding, 300 amp, 30 v for a-c welding; as welder-power combination, unit can also be used as source of single phase, 110/220 v a-c power or 10 kw capacity.

Time Switch . . .

. . . designed for exposed mounting in store interiors and other locations that prohibit use of industrial type cases—*Paragon Electric Co.*, 1609 *Twelfth St., Two Rivers, Wisc.*

Model is rated at 120 v, 60 cycle, 15 amp, 1600 watts, 1 hp, 12 amp full load maximum and 240 v, 60 cycle, 6.5 amp, 1600 watts, 1 hp.

Pipe Clamp . . .

. . . providing even distribution of pressure during tightening—*Adams Pipe Repair Products*, 2453 *Merced Ave., South El Monte, Calif.*

Available for pipe diam from ½ to 8 in. and on special order for pipe diam up to 24 in. and lengths up to 21 in.

Supreme Quality and Character

PREDOMINATE in the SUPERBLY ENGINEERED PRODUCTION of the WORLD'S FINEST REGISTERS and GRILLES

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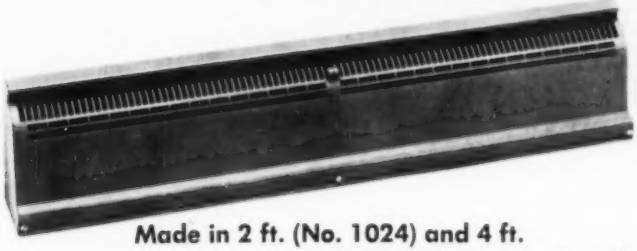
New Improved No. 1000 Series U.S. BASE DIFFUSER



Made in 2 ft. (No. 1024) and 4 ft. (No. 1048) Sizes

More Free Area
More Beautiful Than Ever
More Powerful Than Others
Has More of Everything
Do not Miss the New No. 1000 Line—
U.S. Base Diffusers

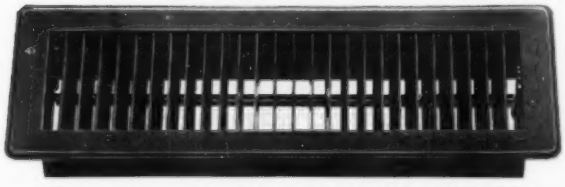
MAXIMUM FREE AREA

No. 1018 U.S. Base Diffuser—Practical for Low-Cost ECONOMY Jobs where Brevity of Length and Capacity is more important—and where Diffusion is more Essential than the SPREAD Distribution of LONGER LENGTH.

Another WINNER for PROJECT WORK

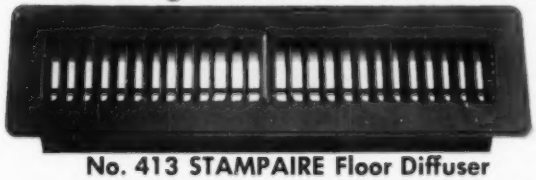
Made in No. 1018 SIZE ONLY —(18″ Length)

We Now Present the New No. 410 U.S. DIFFUSER FLOOR REGISTERS

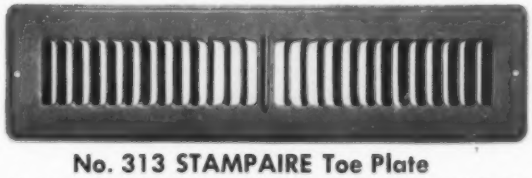


WIDER MARGINS to Cover CRACKAGE due to over-sized Floor Openings. GRADUATED CURVED GRID-BARS to Permit Wide Perfect Even Air Diffusion. Sector-LEVER OPERATOR — Positive Easy Control. SET-SCREW LOCK for System Balancing at the Register.

Presenting the No. 413 STAMPAIRE Floor Diffusers and No. 313 STAMPAIRE Toe Plate



No. 413 STAMPAIRE Floor Diffuser
with Stamped Face for Competitive Project Systems where QUALITY is also Required, which High Quality is still maintained in the No. 413 StampAire. Made in six sizes.



No. 313 STAMPAIRE Toe Plate
for use in Kitchens, Bathrooms, Closets, and Stair Risers where space is limited and Small Amount of Air is Required.

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ON HEATING, COOLING and
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New Vertiflow® Unit Heater
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Catalog 2557

Convector Radiators
Catalog Nos. 4049-A & 4150

Perimaheat® Baseboard Convectors
Catalog No. 4354-A

EQUIPMENT DEVELOPMENTS

Continued

Control Valve . . .

. . . for installation on main supply loop—*Econo Products Co., Div. of Viking Instruments, Inc., East Haddam, Conn.*

Designed to control flow of water to radiation in each zone; when on heating cycle, valve remains open diverting water through radiation until thermostat is satisfied.

Air Sampler . . .

. . . for recording dust or gas concentrations—*Gelman Instrument Co., P.O. Box 86, Chelsea, Mich.*

Consists of portable paper tape which will collect up to 900 dust or gas samples; volume of air is adjustable from 1.5 to 36 cu ft; for dust measurements, darkening of ½ in. diam sampling spot is measured with densitometer; for measuring gases, specially treated paper changes color in presence of many gases.

Centrifugal Fans . . .

. . . capable of delivering 32,000 cfm at static pressure of 2 in. water gage —*du Verre, Inc., P.O. Box 37, Arcade, N. Y.*

Wheel requires 25 hp and rotates at 786 rpm; bulletin "100 gives information and bulletin "105" gives fan specifications and sizings.

Timing Relay . . .

. . . with two normally open and two normally closed timed contacts—*Square D Co., 4041 N. Richards St., Milwaukee 12, Wisc.*

Timing range adjustable from .2 sec to 3 min, with repeat accuracy of ±10 percent; bulletin "9050-7" available on request.

Pipe Reamer . . .

. . . with seven cutting edges—*Ridge Tool Co., Clark St., Elyria, O.*

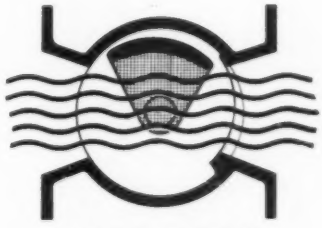
Capable of smoothing inside edges of 3½ to 4 in. pipe and conduit; contains ratchet handle for work in tight quarters.

Do you have Process Piping Problems?

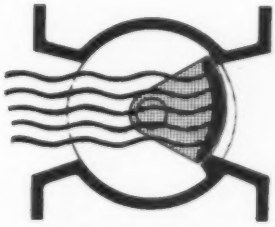
If they involve valves...

DeZurik is your answer!

Here's Why...



WIDE OPEN



DEAD SHUT

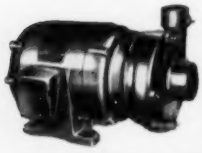
DeZurik Valves are designed on an exclusive eccentric principle which pivots the plug eccentrically in the valve body. The plug touches the body ONLY when the valve is closed! In opening the valve, the first movement of the plug backs it away from the seat — there's no friction, no sticking, no need for lubrication! Tight shut-off is assured by resilient facing bonded to the metal plug. It shuts dead-tight every time — on any line!

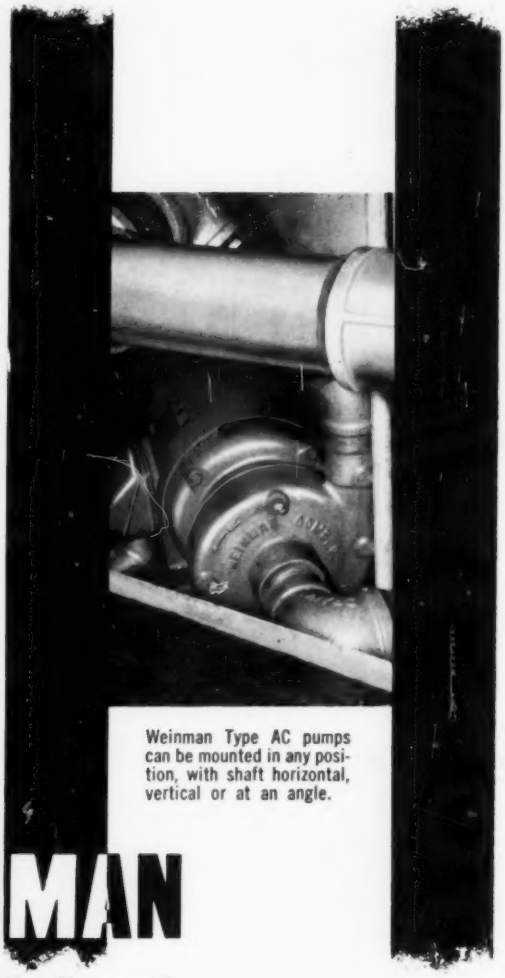
DeZurik Valves have become first choice of plant personnel on so many process lines. In water treatment plants, sewage disposal plants, on air conditioning systems. . . .wherever semi-solid, liquid or gas flows have to be valved, DeZurik Valves do it better, longer!

Available in sizes ½" thru 20", with manual or remote operation, in 2-way, 3-way or 4-way models, in a wide variety of materials. See the DeZurik representative in your area, or write for more information.

DeZURIK CORPORATION
SARTELL, MINNESOTA

take little space, yet pump up to 260 G.P.M.





Weinman Type AC pumps can be mounted in any position, with shaft horizontal, vertical or at an angle.

WEINMAN

air conditioning pumps

There are over 60 Weinman Type AC pump models. Output ratings range up to 260 g.p.m., total dynamic heads to 150; horsepower ratings from ¼ to 7½. This breadth of choice assures you of the model pump exactly matched to any requirement. That's why compact, versatile Weinman Type AC pumps are favorites of air conditioning contractors and equipment manufacturers alike. These pumps take very little space. And, because they operate without trouble in any position, Weinman AC units are easy to mount in tight places.

Talk over your air conditioning pump needs with a Weinman Pump specialist. He's listed in the Yellow Pages. Or, write us for free Bulletin No. 100 — gives full details and performance curves.

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EQUIPMENT DEVELOPMENTS

Continued

Refrigerant Gage . . .

. . . to damp out mechanical vibration and gage point jiggle—*Vilter Mfg. Co., 2148 S. First St., Milwaukee 7, Wisc.*

Designed for bottom-inlet gages weighing up to 2 lb; applicable for use on reciprocating compressors and piping systems in which fluid or gas flow has pulsating characteristics; bulletin "835" available on request.

Ball Check Valve . . .

. . . rated at 100 psi and 300 F maximum—*George W. Dahl Co., Inc., 86 Tupelo St., Bristol, R.I.*

Design utilizes separate ball for each inlet; if both supply pressures fail, two inlets are immediately sealed preventing bleed-off or downstream pressure.

Scotch Boiler . . .

. . . for large school, apartment or store heating—*Federal Boiler Co., Granite and West Sts., Midland Park, N. J.*

Available in 42 full range sizes; sizes range from 1780 through 64,280 sq ft steam or 2850 through 102,850 sq ft water; six page engineering data sheet available on request.

Gas Valves . . .

. . . featuring shut-off disc to reseat—*Marine & Industrial Products Co., North Wales, Pa.*

Available in sizes ½ × ¾ in., ¾ × 1 in., 1 × 1¼ in. and 1½ × 2 in.; service range of valves in size ½ and ¾ in. is up to 350 psig; 1 in. up to 250 psig; 1½ in. up to 200 psig; maximum temperature range is up to 350 F, minimum range to −200 F; descriptive catalog "88" available on request.

Heat Exchanger Tubes . . .

. . . for applications involving different internal and external corrosive operating conditions—*Chase Brass & Copper Co., 236 Grand, Waterbury 20, Conn.*

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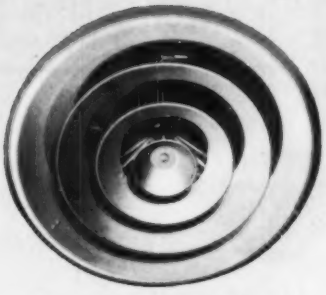
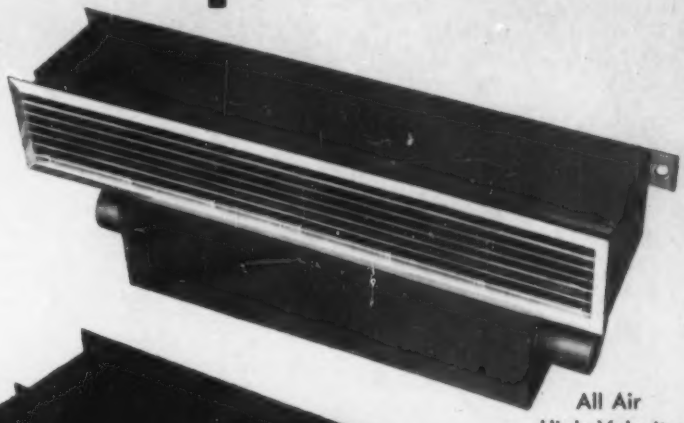
Today Anemostat offers an impressive variety of air diffusion equipment to meet every architectural and engineering requirement. ANEMOSTAT® is a registered trademark. It is your guarantee that every unit bearing this name is of highest quality . . . backed by the most experienced engineering, research and testing laboratories in the industry.

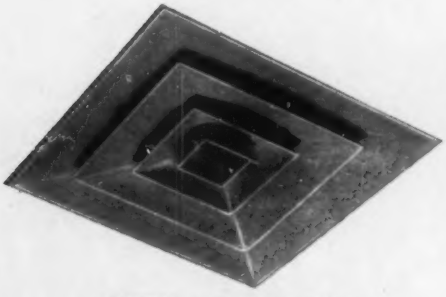
When Anemostat Air Diffusers are in sight the system is right. This was true yesterday, is true today and will be true tomorrow.



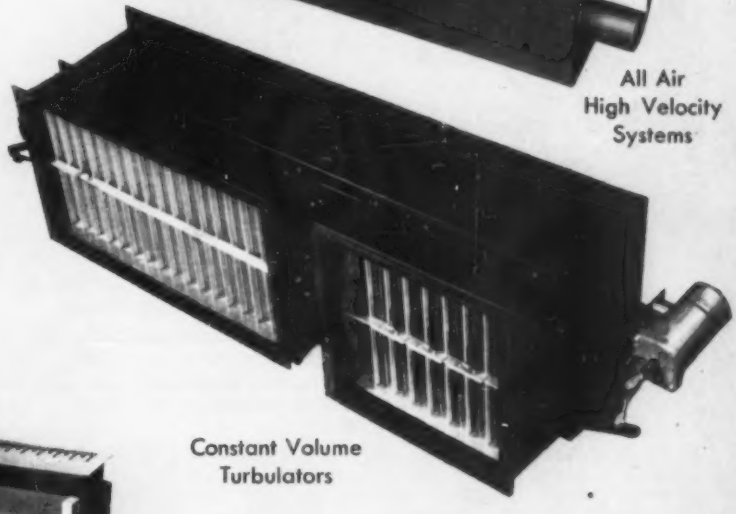
Conventional Air Diffusers



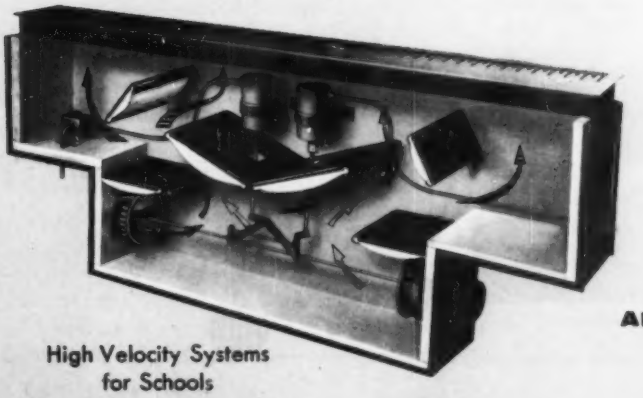
All Air High Velocity Systems



100% Induction Air Diffusers



Constant Volume Turbulators



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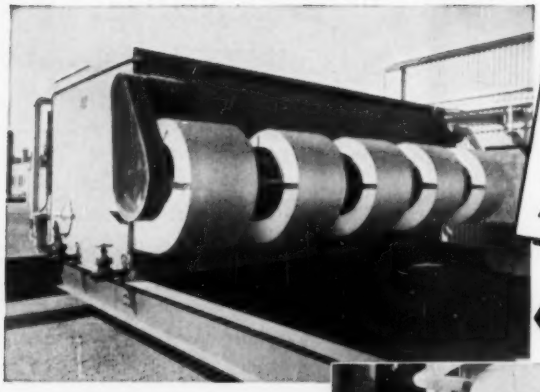
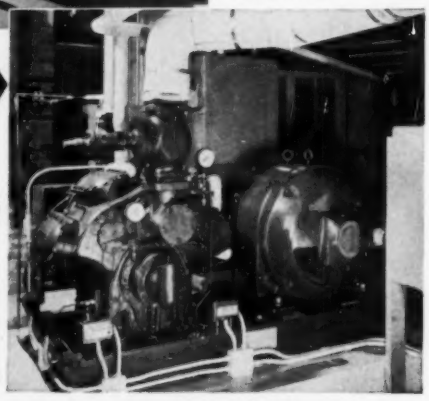


Vilter Report Card

Grade	Service Record
A	Efficient, alternating zone-load operation.
A	Exceptionally low operational cost.
A	Uninterrupted air conditioning service.
A	Smooth operation with minimum maintenance.

View of the Vilter VXF evaporative condenser located on the roof just outside the compressor room.

View of one of the two Vilter 8-cylinder VMC Freon compressors with a 100 h.p., 1175 r.p.m., part winding motor drive. These compressors are located on an upper floor, above an office.



Cool Thinking ... Cool Fun in Marquette University's

Air Conditioned Brooks Memorial Union

Brooks Memorial Union is the hub of many Marquette University activities—professional meetings and conferences attracting a national audience, exciting school dances, excellent food facilities in the cafeteria, snack bar and private dining rooms. One key to its year-'round popularity and usefulness is the air conditioned comfort provided by the Vilter installation on this Milwaukee Campus.

To provide adequate air conditioning on a conservative appropriation and to minimize yearly operating expenses, the system was laid out to provide alternating zone-load cooling based on a "traffic flow" and usage pattern. During normal occupancy the entire Union is cooled. However, at peak loads only part of the conditioned space in Brooks Memorial is cooled at one time. As the peak occupancy load shifts from cafeteria and grill to the ballroom-conference room, the air conditioning is also shifted. Results of operating in this manner have been highly satisfactory.

Vilter equipment furnished on this job included two 8-cylinder VMC compressors; VXF Freon evaporative condenser; Freon liquid receiver; heat exchanger, cooling coils, motors, and controls.

"Very satisfactory performance with only routine maintenance," is the praiseworthy comment by Marquette University officials.

Let Vilter help you with your air conditioning and refrigeration requirements.

Write for these helpful bulletins to: The Vilter Manufacturing Company Dept. F-804, 2217 S. First Street, Milwaukee 7, Wisconsin

Bulletin 631 Vilter Uni-Chiller

Bulletin 820 Vilter VMC Freon Compressors

Bulletin 732 VXF—VSC Evaporative Condensers

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Air Units • Ammonia & Freon Compressors • Booster Compressors • Baudelot Coolers • Water & Brine Coolers • Blast Freezers • Evaporative & Shell & Tube Condensers • Pipe Coils • Valves & Fittings • Pakice & Polarflake Ice Machines

EQUIPMENT DEVELOPMENTS

Continued

Available on combinations of cupro-nickel and other copper alloys with carbon steel, stainless steel, and aluminum; can be supplied in sizes ⅝ to 1 in. OD and ⅜ to 6 in. OD.

Heat Release Actuator . . .

. . . for electronic control systems—*Swartwout Co., Inc.*, 18511 *Euclid Ave., Cleveland, O.*

Develops 300 lb of thrust and has adjustable stroke span of .5 to 1.5 in.; response speed is 0.1 ips.

Butterfly Valve . . .

. . . for applications where two streams flow to or from single pipe—*U.S. Valve & Engineering Co., P.O. Box* 14015, *Houston, Tex.*

Available in 1 through 12 in. sizes; constructed of corrosion resistant materials in either metal-seated or positive sealing.

Variable Speed Sheave . . .

. . . for use on standard V-belts—*T. B. Wood's Sons Co.*, 1275 *Fifth Ave., Chambersburg, Pa.*

Variations of pitch diam are: Q sheaves 1.1 in., B sheaves 1.4 in., C sheaves 2.2 in., D sheaves 3.0 in.; range of capacity is from 5 to 150 hp.

Metal Nibbler . . .

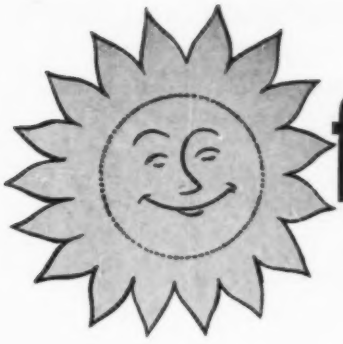
. . . to cut through 8 gage mild steel or 10 gage stainless at rate of 6 ft per min—*Buckeye Tools Corp.*, 5003 *Springboro Pike, Dayton* 1, *O.*

Uses vertical punching motion at high speed to take sharp rectangular ¼ in. wide bites out of metal; uses 90 to 100 psi air through ⅜ in. ID hose for maximum efficiency.

Pipe Insulation . . .

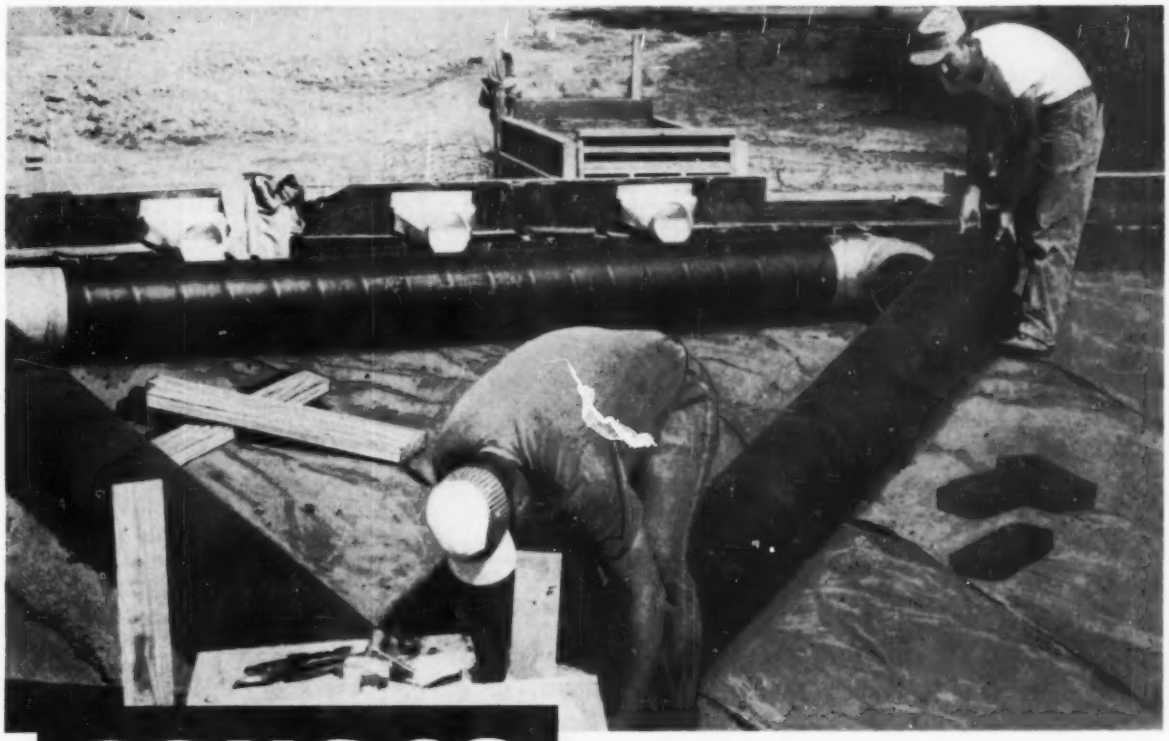
. . . made of expanded polystyrene—*United Cork Companies, Central Ave., Kearny, N. J.*

Available in three standard sizes in both regular or self-extinguishing; nominal 1 in. for temperatures above freezing; nominal 1½ in. for temperatures of 32 F; nominal 2 in. for temperatures of 0 to −30 F; has compression strength of 16 to 20 psi



for heating... for cooling...

install America's best selling FIBRE DUCT!



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SONOAIRDUCT
FIBRE DUCT

ABOVE PHOTO—Taylor University, Upland, Indiana; Oris Eash, Fort Wayne, Ind., architect

Let the original fibre duct—SONOAIRDUCT—help you save time, labor and money on slab perimeter heating or combination heating and cooling systems. Initial cost is low and installation is fast because the lightweight, long lengths are easy to handle and level. There are no sharp, cutting edges, and SONOAIRDUCT will not crack, chip or break when dropped.

Available in 23 sizes — 2" to 36" I.D., in standard shipping lengths of 18'. Special sizes also available. Can be cut to exact lengths with hand saw. SONOAIRDUCT meets and exceeds F.H.A. criteria and test requirements for products in this category. Free installation manual sent on request. See our catalog in Sweet's.

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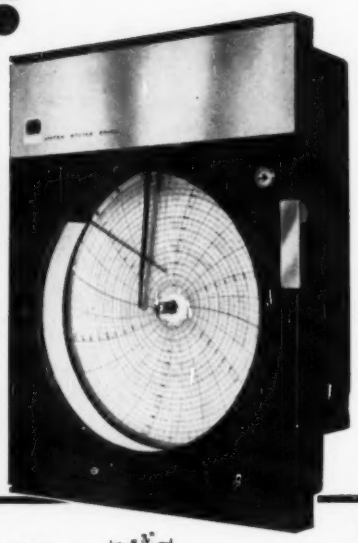
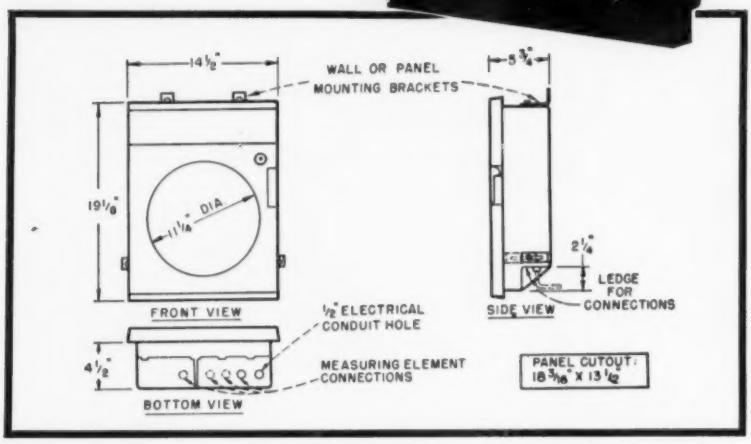
NEW!

MODERNIZED RECORDER HAS UNIVERSAL CASE for all mountings and connections

Also features largest chart opening in the industry





Now, the time-proved, field-proved United States Gauge 12-inch pressure and temperature recorder with completely new, trim, practical exterior design . . . including many important features found only on higher priced instruments. Now, outside and in . . . the USG Recorder offers still more quality, performance and advantages at a money-saving price.

Recessed back. Connections can enter case vertically or horizontally without special mounting.

Largest chart opening in the industry. 11¼-in. diameter for better visibility of chart. Shatterproof glass or blind door optional.

Removable door. New hinge pins permit easy removal of door for access to instrument.

Light weight. Cast aluminum case. Steel back plate provides rigid reference surface for components, prevents recording errors due to stress on case.

Modern design. Enhances modern equipment. Stainless steel escutcheon can be embossed with equipment manufacturer's name.

Fluorescent lighting optional. Ends overheating of case. Improved door skirt increases light on chart.

Dust ledge. Top and bottom. Protects door from dust, moisture.

Ball pivoted pen movements. Exclusive. For 1, 2, 3 or 4 pens.

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permitting use of outside hangers without preparation.

Equipment Briefs . . .

LIQUID FLUX for use with all soft solders—*All-State Welding Alloys Co., Inc.*, 249-55 *Ferris Ave., White Plains, N. Y.* According to manufacturer, may be used on stainless steel, chrome, copper, brass, cast iron, nickel, silver, galvanized, gold, sterling silver, bronze.

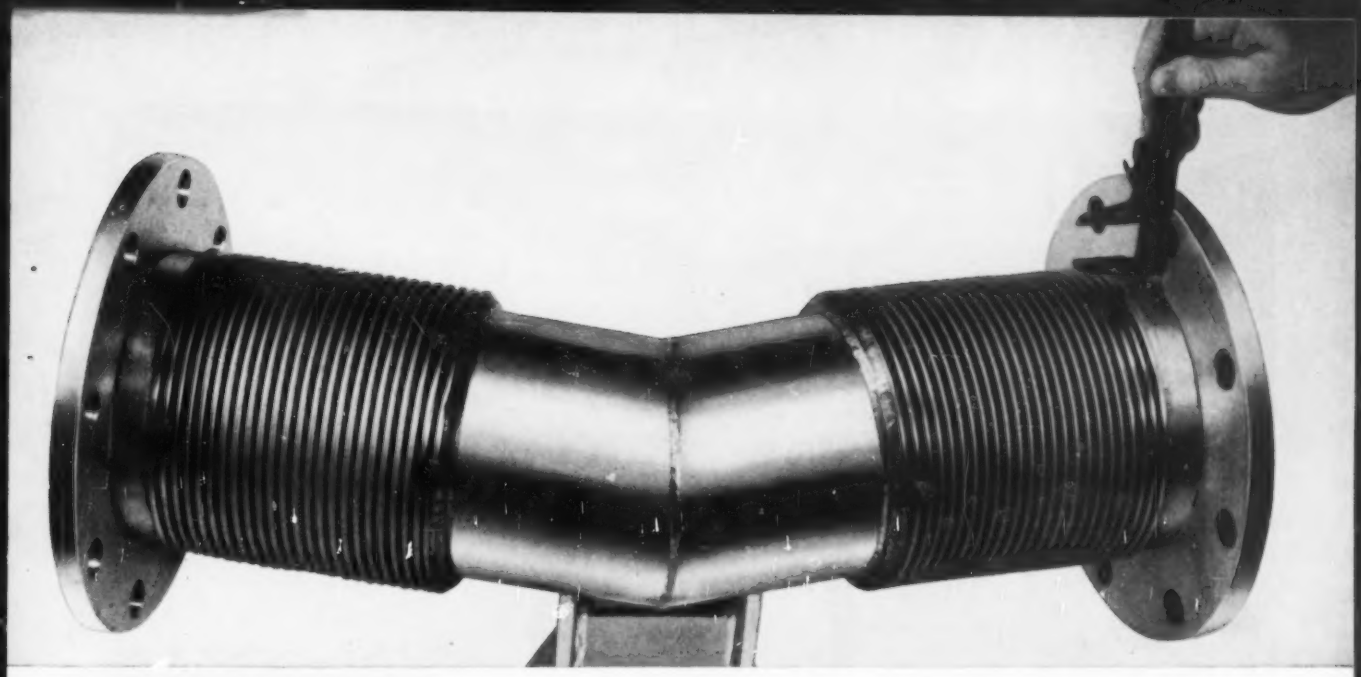
STARTERS, ENCLOSURES of cast aluminum—*Arrow-Hart & Hegeman Electric Co.*, 103 *Hawthorne St., Hartford* 6, *Conn.* Features straight-through front wiring, wide voltage range and epoxy-resin encased coils.

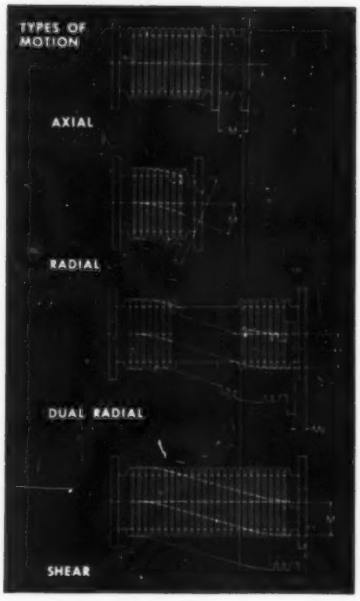
SCALE REMOVER organic chemical which deactivates scale from boilers, heat exchangers, condensers, pipe-lines and refrigeration coils—*Alloy Industries Development Co.*, 2211 *Firestone Blvd., Los Angeles* 2, *Calif.* Contains 9-11 pH and specific gravity of 1.14; chemical is added to 6 gal of water and circulated at temperature of 160-180 F at minimum pressure of 25 psi.

ELECTRIC DRILL featuring three stage gear reduction and gasket sealed leak-proof box—*Porter-Cable Machine Co.*, 111 *Seneca St., Syracuse* 4, *N. Y.* Drill has capacity of ⅜ in. in steel and ¾ in. in wood; has 3.5 amp motor housed in aluminum frame.

CHIMNEY CAP in four models to fit pipe diam from 3 to 8½ in.—*Leslie Welding Co., Inc.*, 2943 *W. Carroll Ave., Chicago* 12. Features adjustable wide-range collar; available in corrosion resistant aluminum in circular louvered design.

TEST BALLS to test copper water lines—*Wade Mfg. Co., Elgin, Ill.*



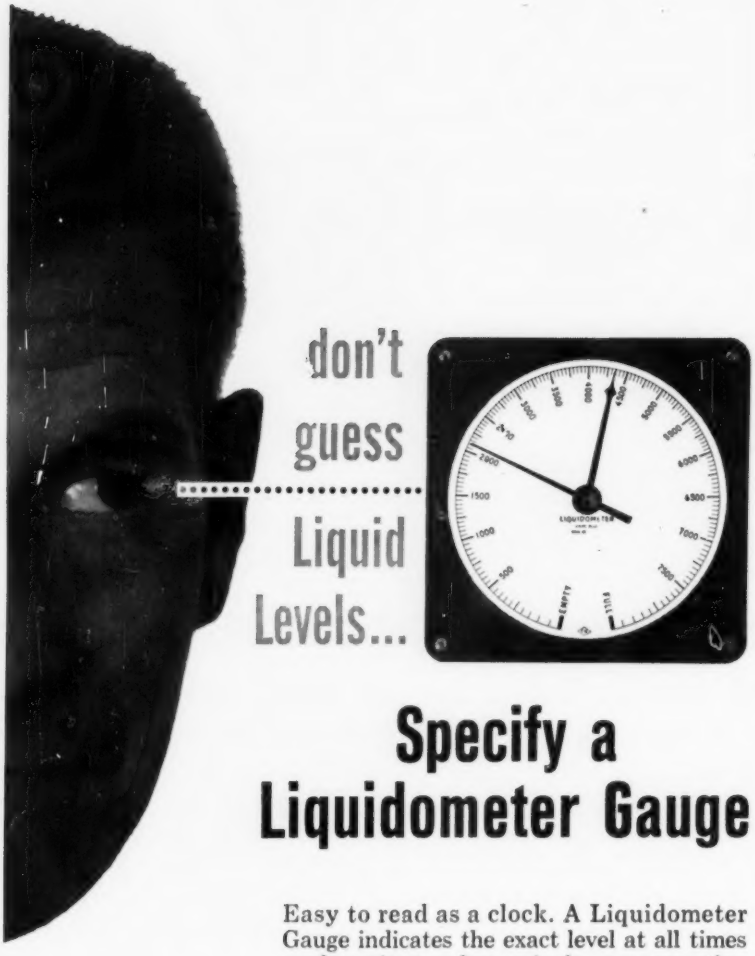


Expansion-joint tubing for big, tough jobs

New AX Tubing by Anaconda is available in Bronze, Stainless Steel, and other metals and alloys—from 4½" I.D. to 14" I.D.—to handle axial and lateral movement.

Need to compensate for contraction of piping suddenly cooled to minus 300°F by a large volume of liquefied gas? Want a bulkhead seal that "gives" with hull movement? Do you need a special assembly like that above, which handles an offset and a combination of lateral and axial movement? Wherever you need large diameter tubing to take care of movement shown in drawing at left, or simple offset, write: Anaconda Metal Hose Division, The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 59125

ANACONDA® METAL HOSE



Specify a Liquidometer Gauge

Easy to read as a clock. A Liquidometer Gauge indicates the exact level at all times ... shows it at a glance. And gauge operation is completely automatic – as far as 250 feet from the tank – without need for auxiliary power of any kind.

A Liquidometer Tank Gauge measures virtually any liquid. It's simple to install – requires no maintenance. Many have provided over 30 years of efficient, dependable service. All are approved by Underwriters' Laboratories and Factory Mutual.

Whether your gauging needs require an automatic Liquidometer Gauge, a hydrostatic Levelometer or a tank-site-indicating Direct Reader, you'll get the best by specifying Liquidometer. For complete details write Dept. A.

Since 1920 ...of proven quality

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LONG ISLAND CITY 1, NEW YORK

EQUIPMENT DEVELOPMENTS
Continued

Available in 1¼ and 1½ in. sizes; ball is inserted into copper tubing, inflated to recommended pressure, deflated by pump disconnection and removed from tubing by attached metal chain.

BOILER CLEANER for reconditioning heating systems—*J. A. Sexauer Mfg. Co.*, 2503-05 *Third Ave., New York* 51. Cleaning compound's action is physical rather than chemical and, according to manufacturer, cleaner coats boiler walls as it cleans.

PIPE COATING package for the pipeline industry—*Chase & Son, Inc., North Quincy, Mass.* Package includes pressure sensitive polyethylene tape and overwrap.

MAGNETIC CONTROLS for constant speed motors—*Arrow-Hart & Hegeman Electric Co.*, 103 *Hawthorn St., Hartford* 6, *Conn.* Available for single and polyphase operation; rated up to 7½ hp at 220 v and 10 hp at 440 and 550 v.

PROTECTIVE COATING to resist weathering of metal, wood, concrete, cloth, plastics—*Minnesota Mining & Mfg. Co.*, 900 *Bush Ave., St. Paul* 6, *Minn.* According to manufacturer, is particularly resistant to 20 percent concentration of hydrochloric and sulfuric acids, distilled and salt water, and alkalis, at continuous service temperatures up to 120 F.

SCALE SOLVENT for tankless heaters, condensers, compressors, pipe lines—*Northeast Consultants, Inc.*, 65 *Concord St., Framingham, Mass.*

TRENCHING MACHINE for use in laying tubing, conduit, and small pipe—*Auburn Machine Works, Inc., Auburn, Neb.* Powered by portable high speed, two cycle chain saw engine; digging chain equipped with digging bits; boom is adjustable to obtain desired depths. ‡

Steel pipe was first choice at Travelers Insurance Company after performance/cost actuarial tables showed the facts

Evaluated on the basis of performance, service life, original cost, installation cost—calculation showed that *steel pipe* could best serve the new Travelers Life Insurance building in Boston for vent and drainage lines, the fire protection sprinkler system and stand-pipe fire lines.

The cost of *steel pipe* when related to the performance advantages was truly significant. And, the savings in initial cost and installation cost were considerable. But these facts are true in most *steel pipe* applications . . . for *steel pipe* is the least expensive and most versatile of all tubular products.

These are the reasons why *steel pipe* is the most widely used pipe in the world for fire sprinkler systems, water transmission lines, vent and drainage lines, structural applications, radiant heating, snow melting, refrigeration, ice making, gas, and air lines, and for electrical conduit.

Simple equipment and tools make steel pipe easy to install anywhere.

STEEL PIPE IS FIRST CHOICE

- Low cost with durability
- Strength unexcelled for safety
- Formable—bends readily
- Weldable—easily, strongly
- Threads smoothly, cleanly
- Sound joints, welded or coupled
- Grades, finishes for all purposes
- Available everywhere from stock

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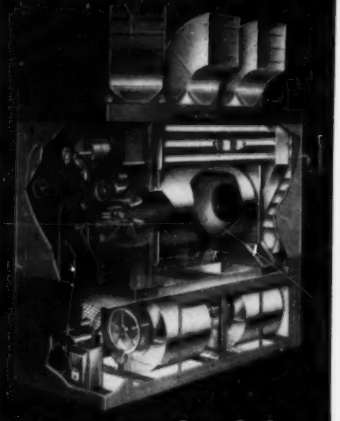
COMMITTEE ON STEEL PIPE RESEARCH

150 East Forty-Second Street, New York 17, N.Y.

LENNOX

"OG" SERIES
INDUSTRIAL HEATER



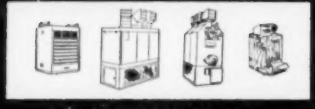
Remarkable Adaptability

Efficient heat transfer design results in reduced physical size of this heater . . . allowing it to take up a minimum of space. If floor space is at a premium, the "OG" can be suspended horizontally or inverted. Removable nozzles permit free standing or ducted installations.

DUAL FUEL
Power Burners

Burner operates equally well with either gas or oil. Changeover is instant and automatic.

LENNOX "Task-Matched" Equipment to control and condition air for industry



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INDUSTRIAL DIVISION
P.O. Box 1294, Dept HP-12
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Please send me—without obligation—complete specifications and engineering data on Lennox "OG" Series Industrial Heaters

Name.....
Company.....
Address.....City.....
Title.....

RECENT TRADE LITERATURE

▸ *A-C CAPACITORS*—for motor starting and continuous duty featured in new catalog No. "9-177"; catalog contains complete listings of dry electrolytic a-c motor starting capacitors and oil impregnated a-c continuous duty capacitors; also included is information on how to select and test motor capacitors as well as replacement cross reference. *P. R. Mallory & Co., P.O. Box* 1885, *Indianapolis* 6, *Ind.*

▸ *BLOWER HOUSING*—for blower wheels ranging from 3 to 11 in. diam described in catalog "122DS-13"; contains dimensional specifications for all standard model housings and components. *Detroit Stamping Co.*, 350 *Midland Ave., Detroit* 3, *Mich.*

▸ *BURNERS, BOILERS*—for heating, processing and power uses discussed in bulletin "AIA-30-C-1"; has complete index and selection chart of commercial and industrial firing equipment as well as complete discussion of basic considerations in choosing combination units. *Iron Fireman Mfg. Co.*, 3170 *W.* 106 *St., Cleveland* 11, *O.*

▸ *BUTTERFLY VALVE*—in size range from 1 to 108 in. with pressure drops up to 1200 psi and temperatures up to 2000 F presented in bulletin "50-1"; valves listed in tabular form including applications, material specifications, positions of installation. *Continental Equipment Co., Division of Fisher Governor Co., Corapolis, Pa.*

▸ *CONTROL TRANSFORMERS*—bulletin "14-BLO1" contains reference chart showing percent of rated load and percent of secondary voltage drop for control transformers used for intermittent or duty-cycle applications; contains detailed information on three basic designs. *Acme Electric Corp., Cuba, N. Y.*

▸ *COOLING TOWERS*—for indoor or outdoor operation detailed in bulletin "KT-104" as well as specifications and construction features; centrifugal fan type has capacity range from 7.5 to 25 tons. *American Air Filter Co., Inc., Dept. PD,* 215 *Central Ave., Louisville* 8, *Ky.*

▸ *COOLING TOWERS*—and their maintenance is subject of technical bulletin "53-3"; bulletin discusses design and characteristics of aluminum as structural component. *Water Service Laboratories, Inc.*, 615 *W.* 131*st St., New York* 27.

▸ *CORROSIVE INHIBITOR*—detailed in form No. "16"; describes uses as a rust preventive. *Rusticide Products Co.*, 3125 *Perkins Ave., Cleveland* 14, *O.*

▸ *DAMPER CONSTRUCTION*—detailed in new chart; chart includes drawings and descriptions on how to make frame, blades, assemble damper. *Duro-Dyne Corp., Route* 110, *Farmingdale, Long Island, N. Y.*

▸ *DRAFT CONTROL*—specification guide available covering commercial and industrial heating systems applications; contains sizing tables, applications, dimension data, sample specification. *H. D. Conkey & Co., Field Control Div., Mendota, Ill.*

▸ *EXTRUDED ALUMINUM*—rods, bars, tubing discussed in technical bulletin "5909"; booklet gives information on mechanical properties, recommended uses, basic extrusion types illustrated and discussed along with standard tolerance factors. *Precision Extrusions, Inc., Green St., Bensenville, Ill.*

▸ *FIBRE DUCT*—installation instructions contained in new pamphlet and bulletin "30-B-2"; contains specifications, sizes and weights. *Sonoco Products Co., Construction Products Div., Hartsville, S. C.*

▸ *FIRE RESISTANT RESINS*—for cores in sandwich type construction, pipe covering, other insulation applications discussed in bulletin "14";

DATA PROCESSING

One of Walton Humidifiers' latest applications is the protection of the accuracy of data systems by proper control of the moisture balance.

Some Walton Applications Include:

	CONSULTANT
Int. Tel. & Tel.	Hudik Rose
Reaction Motors	Wigton Abbott
Barden Corp.	The Austin Company

They Wanted Real Humidification . . . they used Walton

KEEP ABREAST OF HUMIDIFICATION DEVELOPMENTS. Registered architects need only send their name and address to receive Walton's all-inclusive Architects and Engineers File plus the monthly Markets and Methods reports.

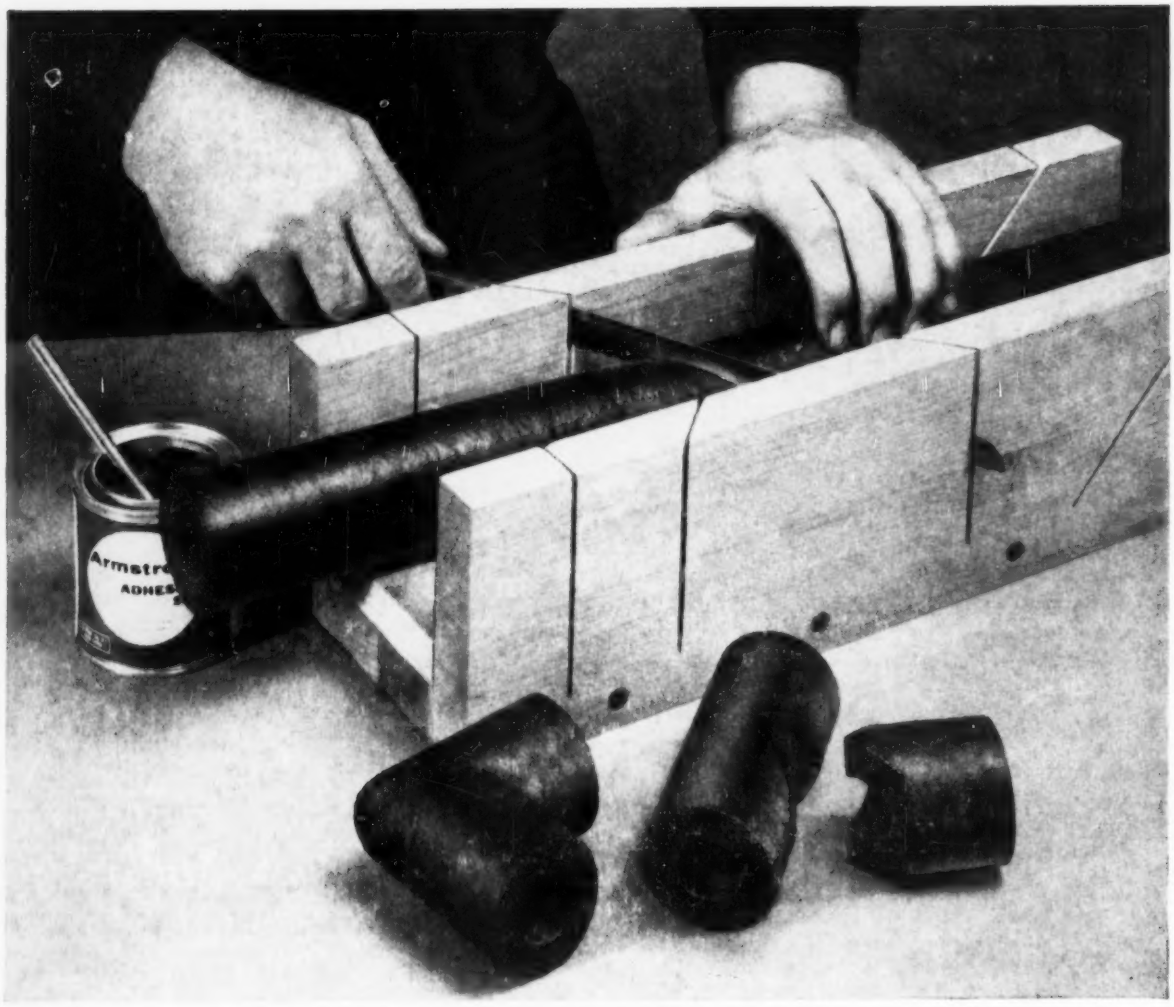
A COMPLETE LINE OF HUMIDIFIERS

. . . For Any Heating, Ventilating or Cooling System
. . . For Existing Systems or Ones Being Planned
. . . For Systems With or Without Ducts
. . . For Special Engineering Projects

All featuring Walton's patented centrifugal atomizer for positive, controlled humidification.

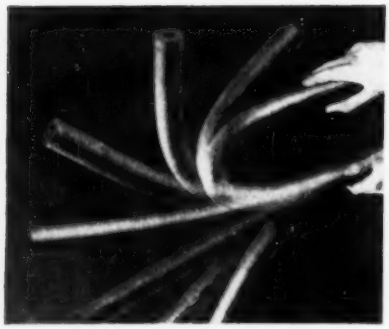
Walton ATOMIZING HUMIDIFIERS

Walton Laboratories, Inc. • Irvington 11, New Jersey
Chicago Office: 548 W. Washington Blvd.



A miter box and a sharp knife are all that are needed to fabricate fitting covers fast with Armaflex.

Insulate fittings 50% faster with Armstrong Armaflex Pipe Covering



Armaflex is extremely flexible, readily follows contours of pipes or bent tubing without special cutting and fitting.

The time it takes to insulate pipe fittings properly can drop 50% or more when Armstrong Armaflex is used. Armaflex is the new, cellular, flexible foamed plastic insulation that is completely waterproof and vaporproof. There's no waste, and it doesn't chip, crumble, or rub off.

To make fitting covers, the material is cut quickly and accurately with a sharp knife. The pieces then are cemented together with Armstrong 520 Adhesive, slit lengthwise, and snapped in place. Since Armaflex is the same vaporproof material that insulates the pipe run, there's no need to buy wrap-on coverings, cements, twine, tape, or waterproof coatings. One insulation does all the work.

An Armaflex job is more than just fast. Fittings look neater, too. And the installation lasts indefinitely. Armaflex stays dry and efficient – will positively stop condensation when used in recommended thicknesses.

For full information on this remarkable pipe covering and complete instructions on how to apply it, write today to Armstrong Cork Company, 2212 Sherman St., Lancaster, Pennsylvania.

Armstrong INSULATIONS

RECENT TRADE LITERATURE

Continued

supplementary information includes essential safety precautions, and sizes of weights and shipping containers available. *Hooker Chemical Corp., P. O. Box* 344, *Niagara Falls, N. Y.*

▸ *FURNACE CONTROLS*—bulletin "B43-1C" contains dimensional data and specifications for variety of temperature and flame controllers. *Minneapolis-Honeywell Regulator Co., Wayne & Windrim Ave., Philadelphia* 44, *Pa.*

▸ *GAS FIRED HEATERS*—of fan and blower types detailed in catalog "SA-5900" containing complete specifications, dimensional and performance data for all categories; includes applications and installation information. *Reznor Mfg. Co.,* 51 *Union St., Mercer, Pa.*

▸ *GAS HEATERS*—for application in remodeling older buildings described in form "7050"; unit has input of 10,000 Btu per hr and may be installed in walls up to 24 in. thick. *Ohio Foundry & Mfg. Co., Penn R. R. & Slack St., Steubenville, O.*

▸ *HEATING, AIR CONDITIONING*—1959-60 catalog for quick selection of blowers, fans, coils, evaporative condensers, valves, fittings; includes guide on cooling towers to 200 tons, air cooled condensers to 300 tons, self-contained air conditioners to 100 tons. *M. Blazer & Son,* 173 *Market St., Passaic, N. J.*

▸ *HEAT PUMP CONTROLS*—which detect and clear outside coils of ice described in engineering bulletin "1748"; contains work sheet pages to record heat pump data. *Ranco, Inc.,* 601 *W. Fifth Ave., Columbus* 1, *O.*

▸ *INDUSTRIAL CONTROLS*—catalog containing information on automatic temperature, pressure, level and flow controls as well as counters, switches and automation controls available when requested on company letterhead. *General Controls Co., Literature Control Section,* 801 *Allen Ave., Glendale* 1, *Calif.*

▸ *LEAK DETECTOR*—bulletin "GEZ-2939" describes operating principles, features and application data; includes maintenance features, installation procedures, and optional accessories. *General Electric Co., Schenectady* 5, *N. Y.*

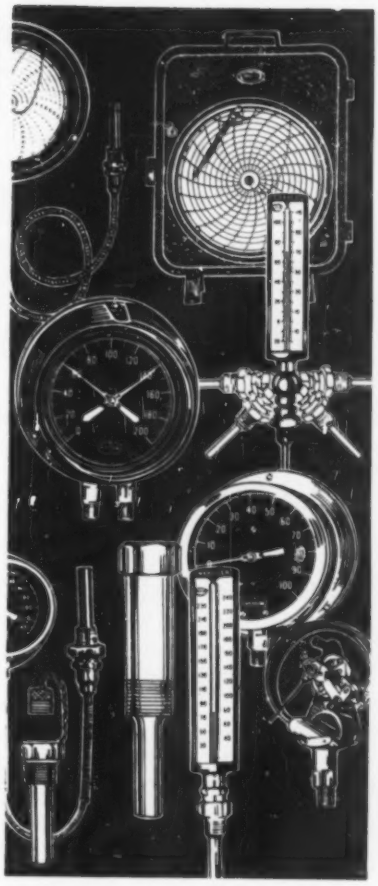
▸ *LEVEL TRANSMITTERS*—for measurement of level over range spans of 1 in. water gage to 2000 in. WG; specification "P31-A" also contains diagram illustrating operation of reset booster relay. *Bailey Meter Co.,* 1050 *Ivanhoe Rd., Cleveland* 10, *O.*

▸ *METAL WORKING TOOLS*—described in 1960 catalog; included are styles, features, dimensions of punches and dies, die shoes, punch holders, strippers, and die adapters. *Whitney Metal Tool Co.,* 110 *Forbes St., Rockford, Ill.*

▸ *MOISTURE DETECTOR*—with sensing element having sensitivity of ± 0.15 percent relative humidity throughout selective ranges of 2 to 99 percent RH; catalog "660" lists equipment for measurement and/or recording of relative humidity, dew point, and moisture content. *American Instrument Co., Inc.,* 8030 *Georgia Ave., Silver Spring, Md.*

▸ *PIPE BENDERS*—pamphlet contains formula data on 90 and 180 deg bends as well as offset; also includes instructions on operation of benders. *Greenlee Tool Co.,* 2136 12*th St., Rockford, Ill.*

▸ *PORTABLE WINCHES*—in capacities up to 5000 lb in new catalog; includes complete specifications on each model as well as illustrated applications. *Therm Machine Co., Winona, Minn.*



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Weksler Instruments for temperature, pressure and humidity applications have been installed in literally thousands of commercial and industrial projects...routine, special, and classified.

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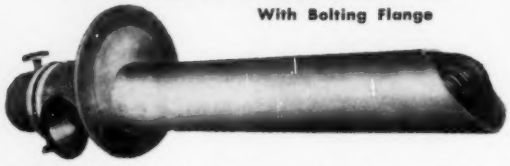
FUEL OIL HEATERS WATER HEATERS and COOLERS

THIS NAMEPLATE IS YOUR GUARANTEE OF QUALITY

- Heat Exchangers
- Condensate Coolers
- Heating Elements
- Converters
- Tank Heaters
- Tankless Water Heaters
- Instantaneous Water Heaters

M & L TANK OUTLET HEATERS
With Bolting Flange



FUNCTION: Installed in bulk storage tanks to prewarm viscous liquids (fuel oil, tar, road oil, molasses, lubricating oil or asphalt) that have been exposed to low temperatures.

CONSTRUCTION: Heads available in either cast iron or steel. Tubes of heavy gauge steel. Tube sheets and baffles of steel.

HEATING MEDIUM: Steam or hot water.

SPECIAL FEATURES: Economical to operate . . . only the liquid that is being withdrawn is heated. Special baffling assures greater efficiency. Can be bolted directly to nozzle. Special swing valve, as optional equipment, permits closing off the shell of suction heaters to enable removal of heads without emptying tank. (not illustrated).

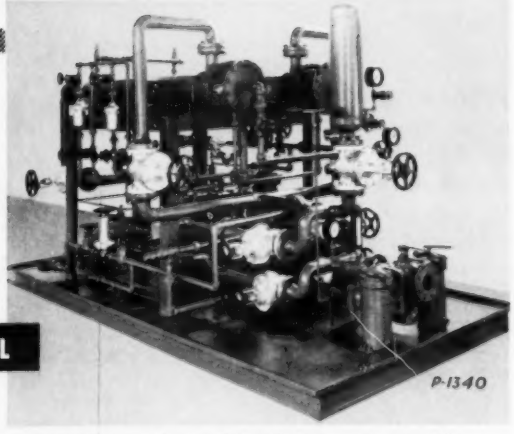
For further details send for your copy of Bulletin # 743.
Dept. "D"

Manning & Lewis
28-42 OGDEN STREET NEWARK 4, NEW JERSEY
M.L.

Fuel Oil Pumping & Heating Units

by

NATIONAL AIROIL



These Units safely prepare heavy fuel oil for firing, and provide: Even oil pressure and temperature • Valving easily understood by operators; designed for minimum pressure drop • Ease of maintenance—space saving • Shipped complete—ready for service connections • Less costy than on-the-job assembly • Available in single or duplex Units—2 to 100 gpm. in standard or special models.

Send for Bulletin 40.

For reliable performance—specify "National Airoil."

The illustration shows a 15 gpm Twin Unit for 300 psig, weather-proofed for out-of-door service, built to meet A.P.I. Safety standards.

National Airoil
BURNER COMPANY, INC.
Main Office & Factory: 1356 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.
SOUTHWESTERN DIVISION 2512 SOUTH BOULEVARD, HOUSTON 6, TEXAS
INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

RECENT TRADE LITERATURE
Continued

▸ *RADIANT HEATERS*—employing spot heating concept described in new brochure; included are typical applications, complete specification and dimensional data on models. *Apextro Products Co., Div. of Apex Sheet Metal Works, Inc.*, 1821 *N. Eastlake Ave., Los Angeles* 31, *Calif.*

▸ *REFLECTIVE INSULATION*—pamphlet describes uses and features; illustrations include how to install insulation in structure. *Reflectal Corp.*, 200 *S. Michigan Ave., Chicago* 4.

▸ *REVERSE RELAY*—operating on force-balance principle detailed in form "P-82"; includes typical and operating specifications, applications, description, construction diagrams. *Powers Regulator Co.*, 3400 *Oakton St., Skokie, Ill.*

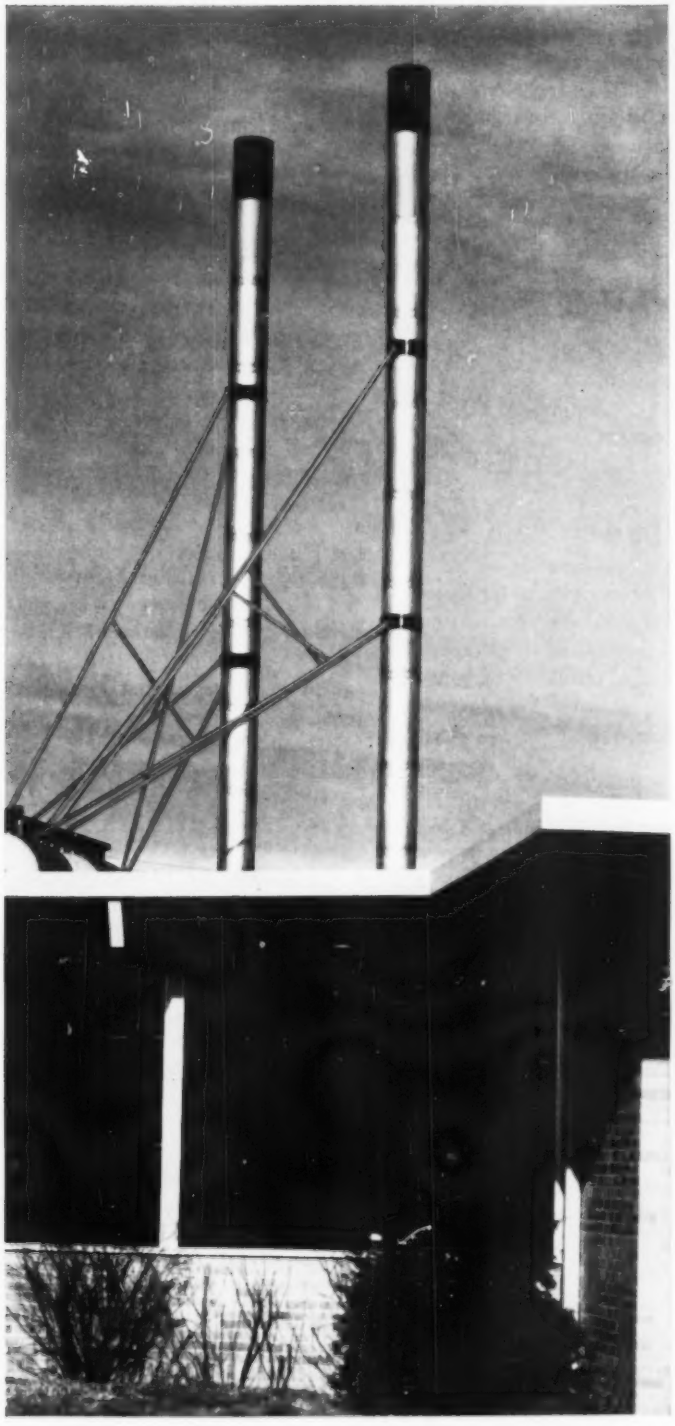
▸ *REVOLVING UNIT HEATERS*—for redistributing warm air from ceiling to floor are described in bulletin "HLC-59"; covers 8 sizes available in either of two types of revolving discharge; tables include dimensions, capacities, and area coverage. *L. J. Wing Mfg. Co.*, 140 *Vreeland Mills Rd., Linden, N. J.*

▸ *SOLENOID VALVE*—selection guide "506" contains engineering information, illustrations and flow diagrams of each type. *Automatic Switch Co., Florham Park, N. J.*

▸ *SUBMERSIBLE PUMPS*—for industry and commercial uses described in 1960 catalog—data file; lists physical dimensions, pumping capacities, electrical data, features. *Kenco Pump Div., American Crucible Products Co.*, 1305 *Oberlin Ave., Lorain, O.*

▸ *TEMPERATURE CONTROLS*—included in catalog "MC-186" are of three types: two are for 50 to 300 F range, one is for 50 to 600 F

UL-listed, factory-built Van-Packer stack goes up fast, is economical, efficient and safe



The two smokestacks pictured at the left will far outlast ordinary steel stacks. They are Van-Packer Factory-Built Smokestacks. They resist corrosive flue-gas acids. They are built to an engineered standard and are always consistent in fabrication quality.

The Van-Packer Smokestack is a factory-built, refractory smokestack centrifugally cast in 3-foot long cylindrical sections. Its outer jacket of corrosion-resistant metal requires no painting. It gives you the advantage of a brick stack at the average price of a steel stack. It's available in eight diameters. It serves commercial and industrial boilers, furnaces and incinerators.

The Van-Packer Model HT Smokestack is safe, as well as efficient and economical. It's the *only* industrial smokestack listed under the Factory Inspection and Label Service Program of Underwriters' Laboratories, Inc.

Investigate the advantages of this refractory stack. It offers substantial economies because it is factory built in large quantities under controlled conditions.

VAN-PACKER®

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In Toronto, Ontario: *The Flintkote Company of Canada, Ltd.*

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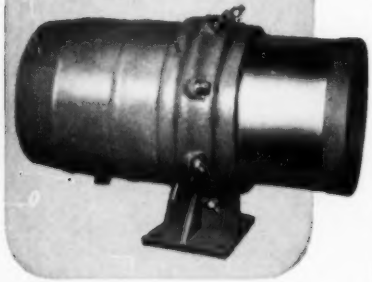
City *Zone* *State*

important points about joints

- Yarway Gun-Pakt Joints are serviced *in the line under full steam pressure.*
- Costly shutdowns eliminated.
- Maintenance records show 1 manhour per year per joint.
- Fewer expansion joints needed per length of pipeline with Gun-Pakt.

YARWAY GUN-PAKT EXPANSION JOINTS



For new Yarway Expansion Joint Catalog EJ-1916 write YARNALL-WARING CO., 107 Mermaid Lane, Phila. 18, Pa.

go YARWAY with confidence

RECENT TRADE LITERATURE

Continued

range; also contains complete specifications. *Fenwal Inc., Pleasant St., Ashland, Mass.*

▸ *THERMOCOUPLE WELLS*—catalog "G102-1" provides information necessary to selection of proper well for any application; includes designs, dimensions, pressure and temperature ratings, corrosion data, assembly information. *Minneapolis-Honeywell Regulator Co., Wayne and Windrim Ave., Philadelphia 44, Pa.*

▸ *TUBE FITTINGS*—used in hydraulic and pneumatic systems contained in catalog "C-301"; includes typical applications, specifications, tube sizes for each fitting. *Weatherhead Co., 128 W. Washington Blvd., Fort Wayne, Ind.*

▸ *TUBE FITTINGS*—bulletin "4306-B1" contains information to aid in selection of proper fittings for various service and installation requirements; includes shape charts for six types of industrial tube fittings. *Parker Fittings & Hose Div., Park-Hannifin Corp., 17325 Euclid Ave., Cleveland 12, O.*

▸ *UNIT HEATER*—for both steam and hot water described in bulletin "1301B"; includes capacity data, conversion factors and basic formulae, typical installation examples. *Dunham-Bush, Inc., 179 South St., Hartford 10, Conn.*

▸ *VALVE SELECTION*—guide form "1012" includes cross index of complete line, valve trim chart, list of frequently used abbreviations; also contains breakdown by valve material, pressure class, type, disc design, seating arrangement, stem operation, and end connection. *Ohio Injector Co., 275 Main St., Wadsworth, O.*

▸ *WATER TREATMENT*—case histories included in technical reprint "T-176"; paper includes tables, curves, flow diagrams, and illustrations. *Graver Water Conditioning Co., 216 W. 14th St., New York 11.*

▸ *WELDING DEVICES* — including torches, cutting attachments, tips, flowmeter, regulators, refrigerant leak detector, blowpipes, and gas shut-off valves illustrated in catalog "NR-175"; also lists and describes various industrial gases. *National Cylinder Gas Div., of Chemetron Corp., 840 N. Michigan Ave., Chicago 11.*

▸ *WELDING ELECTRODES* — of four types contained in bulletin "NH-103T"; bulletin contains typical applications including welding of storage tanks, steel structures, pressure vessels, steam piping; includes diagrams of correct operating positions. *National Cylinder Gas Div., of Chemetron Corp., 840 N. Michigan Ave., Chicago 11.*

▸ *WELDING FASTENERS* — in new book which contains complete standard designs and specifications; includes complete engineering data, weight charts, machining operations; requests should be made on company letterhead. *K S M Products, Inc., Yale & Woodland Ave., Merchantville 8, N. J.*

▸ *WELDING FITTINGS* — and flanges in 26 in. nominal pipe sizes detailed in technical bulletin "FDC-273"; includes diagrams, chart listing dimensions and weights of various types of fittings. *Babcock & Wilcox Co., Tubular Products Div., Welding Fittings Dept., Milwaukee, 46, Wisc.*

▸ *WET-DRY BULB SYSTEMS* — used in thermometers-psychrometers described in specification "S690-3"; includes water supply accessories for wet bulbs, lists recorders and electric and pneumatic control models available for relative humidity. *Minneapolis-Honeywell Regulator Co., Wayne & Windrim Ave., Philadelphia 44, Pa.* ≠

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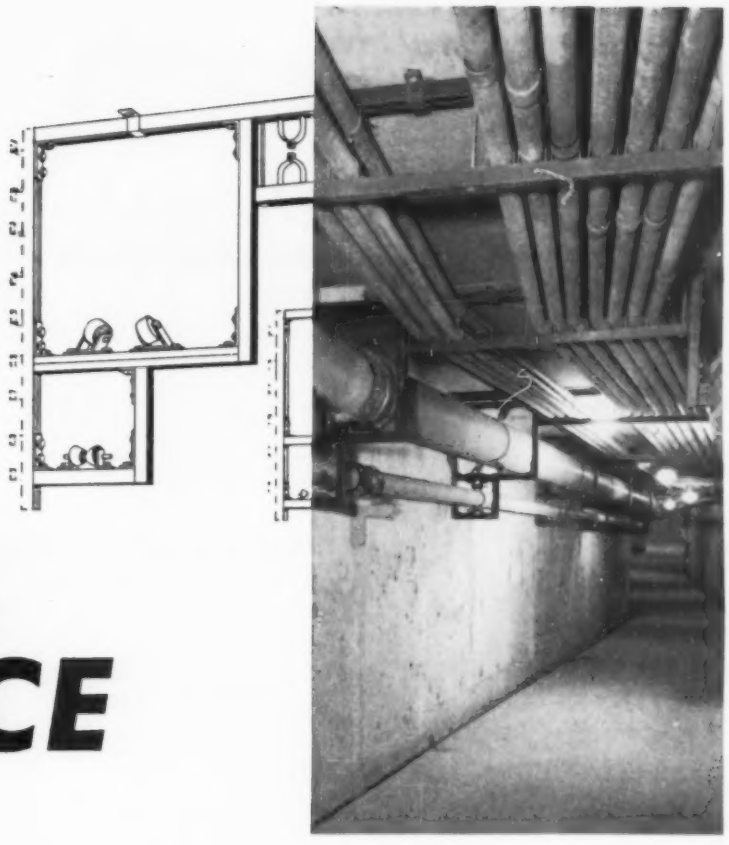
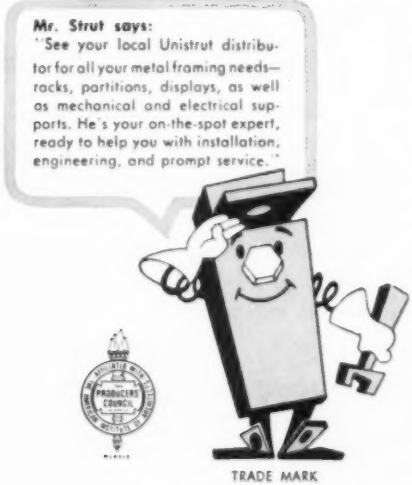


on the world's most complete line of mechanical and electrical supports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WHO'S WHAT

▸ *SIEGLER CORP.*—Robert K. Miller, vice president; A. Henry Casey, director of corporate public relations and advertising.

▸ *CARRIER CORP.*—Dr. Stanley F. Gilman, manager of compressor development for unitary equipment division.

▸ *WESTINGHOUSE ELECTRIC CORP.*—William E. Hoctor, manager of manufacturing.

▸ *PLUMBING-HEATING-COOLING INFORMATION BUREAU*—president: William A. Fitzpatrick, general manager, M. J. Gibbons Supply Co.; vice president: Lee Martin, president of NIBCO, Inc.; treasurer: John M. Dumser, director of sales, Wolverine Tube, Division of Calumet & Hecla, Inc.; secretary: Norman J. Radder; executive director: Norman Wicks.

▸ *SCHEMENAUER MFG. CO.*—Edward C. Liebrecht, sales manager.

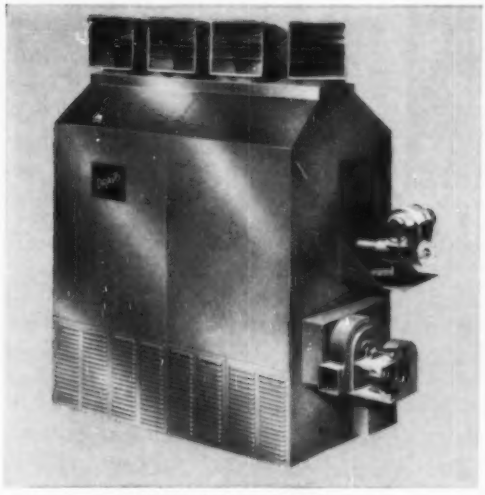
▸ *SWARTWOUT CO.*—Robert Mueller, assistant treasurer.

▸ *HOOKER CHEMICAL CORP.*—Arthur P. Schulze, appointed to public relations dept.

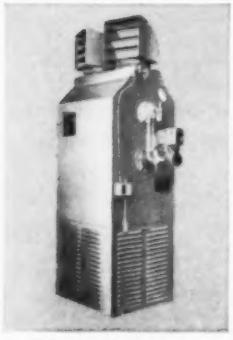
▸ *YORK DIV., BORG-WARNER CORP.*—R. J. Halloran and M. S. Lebair, vice president.

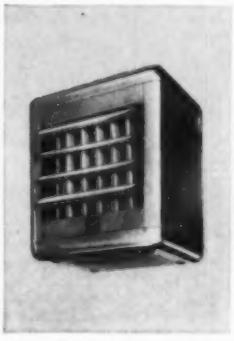
▸ *AMERICAN-STANDARD INDUSTRIAL DIVISION*—James W. Hosler, general sales manager; Richard J. Riedl, product manager.

▸ *STRONG, CARLISLE & HAMMOND*—Joseph P. Stroz, chief engineer.

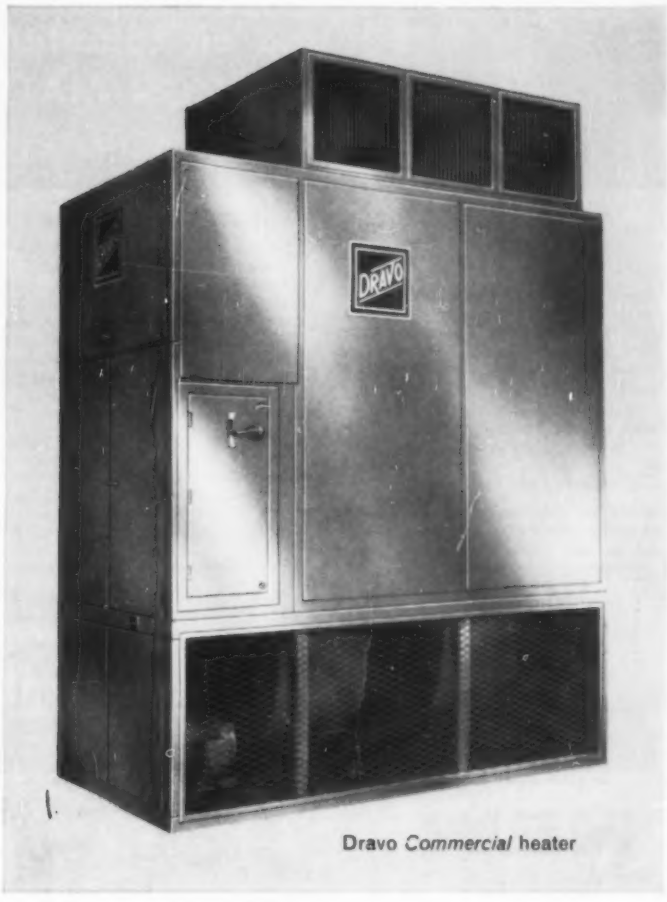


Dravo *Industrial* heater





Dravo *Paraflo* heater and *Suspended Unit* heater



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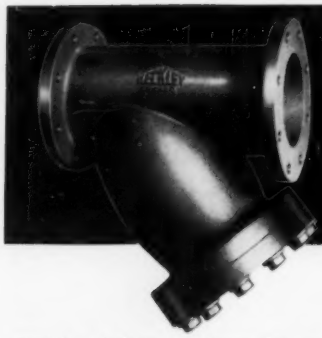

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Specify Keckley Strainers for safe, sure removal of foreign matter from distribution systems — *ahead* of pre-heat and re-heat coils, control valves, steam traps, pumps and other equipment.

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Y-Type Self-Cleaning Strainers

In ¼" to 12" pipe sizes in semi-steel bodies to 250 lbs. steam, bronze bodies to 300 lbs. steam, and cast steel bodies to 600 lbs. steam. Screwed or flanged connections. All size perforated brass, stainless steel or monel screens available, as well as wire meshes, for proper media selection.

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For pressure and suction pipe lines. Basket lifts from top, cleans easily. Semi-steel bodies to 250 psi, bronze bodies to 300 psi, and steel bodies to 600 psi. Brass or stainless steel screens. Also available with vertical blow down.

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NEW VM neoprene-in-shear

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REDUCE NOISE ABSORB VIBRATION

Control noise and vibration in fans, pumps, air conditioning machines, etc. with these new VM Vibration Mountings, made with tough, absorbent neoprene!

NEW "R" SERIES Mountings of bonded neoprene-in-shear molded in five degrees of rubber hardness for maximum deflection within each load range: 10 to 4000 lbs. Five colors to identify capacity, simplify stocking, prevent installation errors.

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WHO'S WHAT

Continued

▸ *CLAY FLUE LINING INSTITUTE*—president: James L. Clough, Evans Brick Co.; vice president: A. R. Thorson, Mill Hall Clay Products, Inc.; secretary: Robert F. Larson, Natco Corp.; treasurer: Philip E. Kopp, Malvern Flue Lining, Inc.

▸ *TUBE TURNS DIV. OF CHEMETRON CORP.*—James M. Gloor, works manager; Morry T. Wakefield, production superintendent; Max B. Densford, personnel manager; Henry H. George, chief engineer; Everett C. Rodabaugh, principal research engineer; Fred C. Smith, director of quality control.

▸ *DUNHAM-BUSH, INC.*—Les Garnsey, secretary.

▸ *PITTSBURGH PLATE GLASS CO.*—Thomas F. Mitchell, flat glass marketing research; Thomas R. Aberant, paint sales market research; Norman F. Heydinger, fiber glass departmental operations; Alvan C. Gross, sales forecasting in glass division; John S. Burns, market research in basic research on pricing policies.

▸ *ARCRODS CORP.*—H. M. Peterson, vice president and controller.

▸ *BABCOCK & WILCOX CO.*—J. R. Connell, purchasing agent of the boiler division; J. P. Craven, vice president; O. R. Carpenter, assistant vice president, boiler division.

▸ *BROWN FINTUBE CO.*—John W. Nevins, chief engineer.

▸ *AMERICAN GAGE & MACHINE CO.*—William F. Huck, director.

WHO'S WHAT

Continued

▸ *PANGBORN CORP.*—John C. Cleeves, development engineer.

▸ *TRANE CO.*—Kenneth C. Mirov, manager, San Francisco office.

▸ *ARMSTRONG CORK CO.*—Dr. Calvin E. Schildknecht, consultant.

▸ *GREENLEE TOOL CO.*—Martin J. Tuckett, general sales manager.

▸ *EMERSON ELECTRIC MFG. CO*—Floyd C. Weaver, open motor sales supervisor.

▸ *OLIN MATHIESON CHEMICAL CORP.*—John F. Hack, national accounts manager for Western Brass sales, metals division.

▸ *WARREN BARR SUPPLY CO.*—Donald R. MacCrimmon, vice president of industrial sales; Norman I. Pickles, secretary-treasurer.

▸ *MARSH INSTRUMENT CO.*—W. M. Ensign, sales service manager.

▸ *THOR POWER TOOL CO.*—John L. MacDonald, manager of sales training dept.

▸ *BUFFALO FORGE CO.*—George P. Schively, to board of directors; Milford E. Reiner, treasurer.

▸ *MIDWEST PIPING CO., INC.*—Norman B. Champ, Jr., vice president.

▸ *MAXITROL CO.*—Clifford A. Terry, chief tool engineer.

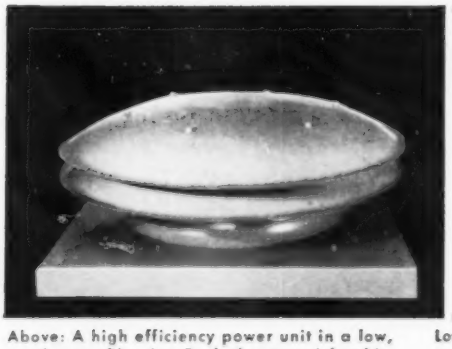
▸ *ARMCO STEEL CORP.*—Edgar L. Bands, superintendent of hot strip mill, Ashland works; William T. Watson, superintendent of shipping.

▸ *IRON FIREMEN MFG CO.*—Earl L. Pedard, to engineering staff.

▸ *THERMO ELECTRIC CO., INC.*—William Knesby, application engineer.

▸ *OIL HEAT INSTITUTE OF AMERICA*—chairman of 38th annual convention: Everett Elliott, president C. L. Elliott Co.

NEW AXIAL ROOF VENTILATORS BY WESTERN

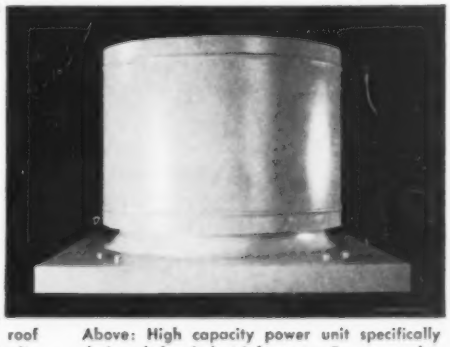


Above: A high efficiency power unit in a low, weather-proof housing. For both commercial and industrial use. 360 degree near horizontal discharge. Aerodynamically correct spun housing. Heavy guage steel, aluminum or non-corrosive Fiberglas* construction.

◀ **The Westernaire®** Low Silhouette Hooded Exhaust Ventilator

The Westernaire® Low Silhouette Vertical Exhaust Ventilator ▶

Low silhouette high efficiency power roof ventilators for vertical or horizontal air discharge provide motor mounting below the venturi to achieve styling compatible with modern architecture plus a smooth airstream discharge pattern.



Above: High capacity power unit specifically designed for industrial usage. Fumes, smoke, dust-laden and foul air projected high above roof to prevent re-entry into building. "Blow-open" dampers rest on neoprene seal. Completely weatherproof.

Other type ventilators include: Rotary, Stationary, Directional, Continuous Ridge, Unit, Power models.

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P. O. BOX 66455, LOS ANGELES 66, CALIFORNIA

*TM- Owens Corning Fiberglas Corp.

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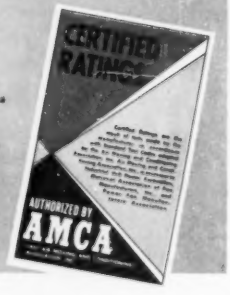
Type BB Fan

Aladdin
AIR HANDLING EQUIPMENT

For EFFICIENCY and QUIET OPERATION...

CERTIFIED PERFORMANCE



ALADDIN Type BB Fans are the first choice of many engineers for heating, ventilating and air conditioning jobs. Designed for low rotational speeds and high efficiency, these fans insure that stable performance from free delivery to shutoff that engineers have come to expect of this type of equipment.

In designing the BB Fan, Aladdin engineers have refused to short-cut quality, each fan is ruggedly built and is backed by thirty-five years of experience and manufacturing know-how.

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1111 WEST AVENUE 137 • SAN LEANDRO, CALIFORNIA

WHO'S WHAT

Continued

▸ *DRAVO CORP.*—Carl B. Jansen, chairman of the board. C. R. Boyer, manager of light metals dept.

▸ *LIMBACH CO.*—James F. Sasser, staff manager, mechanical division and chief engineer; Alan Marcus, manager of mechanical dept.

▸ *NORMAN PRODUCTS CO.*—M. H. Thomas, assistant to the president; Richard G. Millikan, sales manager.

▸ *UNITED ELECTRIC CONTROLS CO.*—George W. Clapp, sales manager.

▸ *MITCHELL SPECIALTY DIV. OF INDUSTRIAL ENTERPRISES, INC.*—Alan J. Brelau, technical director; Jack Dunnous, director of systems development.

IN THE TERRITORIES . . .

(Recent sales appointments)

▸ *PITTSBURGH CORNING CORP.* — Gordon Ross McKissack, sales representative in Houston, Texas office; Harry E. Porter, regional sales manager, southwest and west coast areas.

▸ *KEE KLAMPS NORTH AMERICA LTD.* — L. Ward, Steel Products sales representative, Texas.

▸ *WESTINGHOUSE ELECTRIC CORP., STURTEVANT DIV.* — Marion J. Kolasa, Detroit district manager.

▸ *OAKITE PRODUCTS, INC.* — Ted A. Rohlfsen, south Pacific coast division manager.

▸ *A. M. BYERS CO.* — Tennessee York Supply Co., distributor.

▸ *STODDARD INDUSTRIES* — A. P. Equipment Co., representative in St. Louis and surrounding territory; Arthur E. Duwe, representative in Milwaukee and Wisconsin territory.

WHO'S WHAT

Continued

▸ *PARKER-HANNIFIN CORP.* — Midwest Fluid Power Co., distributor.

▸ *LUNKENHEIMER CO.* — J. R. Callaway, representative in north Texas, Lubbock, Midland, Odessa, Hobbs territories.

▸ *WOLVERINE TUBE, DIV. OF CALUMET & HECLA, INC.* — K. F. Egan, representative in New York district.

▸ *AMERICAN BRASS CO.* — James L. Marvin, assistant sales manager, Kenosha, Wisc. division.

▸ *EMERSON ELECTRIC MFG. CO.* — Jack Rogers, regional sales manager; Bill Richard, lighting specialist; salesmen: Jack Drake, Charles Strauss, Dennis Cassidy, Gordon Laursen, Gerald Andrews; for new sales region including all of New Mexico, Texas, Oklahoma, Arkansas, northern Mississippi, western Tennessee, western Louisiana.

▸ *SETON NAME PLATE CO.* — Nathan Co., distributor in northern counties of Texas.

▸ *BROWN FINTUBE CO.* — Maloney Industrial Equipment Co., representative in Buffalo and Cincinnati areas.

▸ *CLEVELAND HEATER CO.* — George L. Tillinghas, Jr., manufacturers representative in eastern New England area.

▸ *CARRIER CORP.* — J. D. Wilson Co., Inc., distributor in Madison, Stevens Point, Wausau, Wisc.

▸ *RESEARCH PRODUCTS CORP.* — Glenn A. Olsen, district salesman in Arkansas, Oklahoma, north Texas, and Memphis, Tennessee.

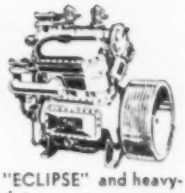
▸ *PROTECTION CONTROLS, INC.* — Smith Combustion Equipment Co., Chicago sales representative; Instrument Service & Equipment Co., Cleveland sales representative.

▸ *OTTO BERNZ CO., INC.* — Added Sales Co., sales representative in Illinois and Wisconsin.

▸ *HEIL-QUAKER CORP.* — Howard Krueger, district sales manager for Michigan.

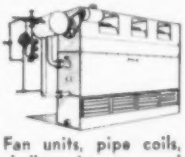
We have all the components

FRICK DISTRIBUTORS *and* FRICK USERS can select from the industry's greatest line of compressors, condensers, coolers, coils and controls.



"ECLIPSE" and heavy-duty compressors: sizes up to 1,000 tons refrigeration.

They also get the advantages of many exclusive Frick engineering developments, a few of which are illustrated. When you or your clients need air conditioning, refrigeration, ice making or quick freezing equipment, in any commercial or industrial sizes, check first with Frick.

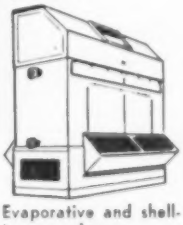


Fan units, pipe coils, shell, zig-zag and other types of coolers for air, water, brine, etc.

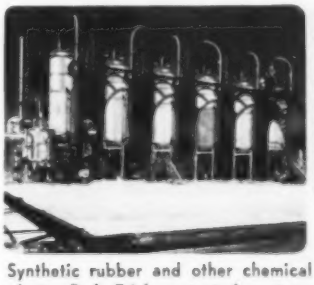
DEPENDABLE REFRIGERATION SINCE 1888
FRICK CO.
WAYNESBORO, PENNA., U.S.A.

Valves, Fittings and Controls, for manual or full-automatic operation.

Prestfin coils have 9 to 13 times the surface of bare pipe, assure high humidity in storage. Also remove superheat from hot gases.



Evaporative and shell-type condensers.



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Shell-Ice is frozen automatically on stainless-steel tubes, is hard and clear. Preferred in fountains, restaurants, dairies, poultry plants, fisheries, by shippers, etc.

PROBLEM:

Cooling towers—find a nozzle that delivers large droplets at low pressure

SOLUTION:

Delavan Types WR or WC nozzles

Both these Delavan nozzles operate effectively at pressures as low as 2 psi. Produce large droplets with minimum drift-age. Clogging is held to a minimum. There are no vanes, cores or other obstruction to promote corrosion build-up. WR and WC deliver uniformly distributed, hollow cone patterns for maximum heat transfer. They're accurately calibrated to the capacity and spray angle you request. A wide range of capacities, pipe sizes and materials is available.

If the right nozzle will improve your air conditioning equipment, there's a Delavan nozzle that will do it better. Write for Catalog 33A today.

DELAVAN
Manufacturing Company
WORLD'S LARGEST MANUFACTURER OF NOZZLES • WEST DES MOINES • IOWA

WHO'S WHAT

Continued

▸ *MUELLER BRASS CO.* — Thomas E. Rickelman, sales representative in Melrose Park, Ill. office; L. C. Lucas, district sales manager, Grand Rapids, Michigan territory.

▸ *DONOVAN ASSOCIATES* — Guy DeFoe, southern Connecticut representative.

▸ *WM. POWELL CO.* — Wm. J. Mercier, Wisconsin and upper peninsula of Michigan sales engineer; Wm. E. Welch, Colorado, Montana, Nevada, Utah, Wyoming sales engineer; Wm. H. Marshall, San Francisco, central and upper California sales engineer; H. Alton Pearson, Philadelphia, Chester, eastern Pennsylvania sales engineer; Donald O. Petterson, Oklahoma, Kansas, part of Missouri sales engineer.

▸ *ATLAS VALVE CO.* — D. R. Whipple sales representative in eastern New York State; John Stark, representative in Colorado and southern Wyoming; Control Instrumentation Co., to handle sales in northern California.

▸ *RAMSET FASTENING SYSTEM — OLIN MATHIESON CHEMICAL CORP.* — Henry G. Walesch, field sales manager.

▸ *E. I. du PONT de NEMOURS & CO.* — Robert Wright, Jr., sales supervisor, Chicago district.

▸ *AJAX FLEXIBLE COUPLING CO., INC.* — Harkins Engineering Co., sales representative.

▸ *OHIO BRASS CO.* — Robert J. Schnug, district manager in Ohio, Michigan, West Virginia, parts of Kentucky, Indiana, Maryland, Pennsylvania and New York.

▸ *WESTERN ENGINEERING & MFG. CO.* — Marshall, Neil & Pauley, Inc., factory representative in Houston and Dallas, Texas; Foster-Bray Co., Inc., factory representative in Seattle, Washington; George D. Montag, representative in Portland, Oregon; General Equipment Co., representative in Spokane, Washington.

▸ *DETROIT STOKER CO.*—John C. Rutter, assistant to New York district manager; Robert H. Schenker, Philadelphia district representative including eastern Pennsylvania, southern New Jersey, Maryland, Delaware, and District of Columbia.

WHO'S WHAT

Continued

▸ *McQUAY, INC.* — A. R. Bowman Co., sales representative in Rochester, N. Y. territory.

▸ *AUTOMATIC CONTROL CO.* — O'Brien Engineering Co., service representative in Chicago.

▸ *ALLIS-CHALMERS MFG. CO.* — J. A. Longley, regional representative for Pacific region transmission and distribution equipment; T. E. Meyers, manager, San Francisco district; G. K. Lewis, manager Portland district.

▸ *MODINE MFG. CO.* — James W. Hall, southeastern regional manager.

▸ *DAYTON INDUSTRIAL PRODUCTS CO.* — Leo Miller, southern regional industrial sales manager.

▸ *MIDWEST PIPING CO., INC.* — Louis H. Niebling, general manager of southwest operation; Walter J. Janesch, Chicago district manager; N. G. Saldana, Chicago sales manager for fabrication and construction.

▸ *MINNEAPOLIS-HONEYWELL REGULATOR CO.* —Frank P. Kelly, manager of manufacturing operations.

▸ *E. I. du PONT de NEMOURS & CO.*—Dr. Frank E. French, Jr., manager of new product and market development.

▸ *PACIFIC STEEL BOILER DIV. NATIONAL-U. S. RADIATOR CORP.*—O. M. Jones Co., sales representative in 9 far western counties of Virginia; R. P. Fedder, new sales representative for Rochester area; Wilson-Brinker Assoc., Inc., representative in western Michigan; Heet-Flo Co., sales representative for Los Angeles area; Mason & Barry, Inc., sales representative in West Virginia.

▸ *YUBA CONSOLIDATED INDUSTRIES, INC.*— T. B. Leech, vice president and director of export sales.

▸ *BRUNER CORP.*—G. C. Wehane, vice president and general manager, western division facilities. ∓

DO YOU FIND YOUR PUMP PROBLEM HERE?

A Water Supply, Air Conditioning, Refrigeration, Cooling Towers, Sump Pumping, Etc.

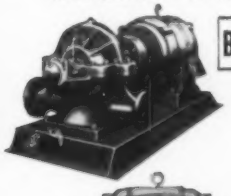
B Booster Service, Cooling Towers, Water Treatment, Water Circulation, Brine Service, Etc.

C Hot Water Circulation, Ice Water or Brine, Clear Water, Boilers, Booster Service, Etc.

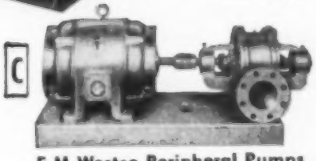
D Hot and Cold Liquids, Refrigerants, Boiler Feed, Cooling Towers

Then You'll Find Your Best Answer Here—

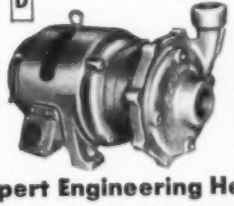
A **F-M Pomona Water-Lubricated Turbine Pumps** Easily installed, easy to adjust for varying field conditions. Available with wide choice of drivers.



B **F-M Split-Case Centrifugal Pumps** Capacities, pressures and sizes for any requirements. Single-stage or multistage.



C **F-M Westco Peripheral Pumps** Capacities to 200 gpm. Pressures to 900 ft. Sizes 1½" through 2½". Horizontal single-stage or multistage. Develops high pressure at normal operating speeds.



D **F-M Builtogether Centrifugal Pumps** Capacities to 900 gpm. Pressures to 525 ft. Sizes ¾" through 5". Single-stage or multistage.

***FREE!* Expert Engineering Help at Your Service**

Be *sure* of low-cost, foolproof pumping installations that match your exact requirements...call in your Fairbanks-Morse Sales Engineer. Take advantage of his broad technical background and expert knowledge of pumps for air conditioning, plumbing and heating. Call him today, or write Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Illinois.

See Sweet's Product Design Catalog File for complete F-M Pump Line.

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY
RAIL CARS • HOME WATER SERVICE EQUIPMENT • MAGNETOS

where efficiency really counts...

Therm-O-Tile

IS THE CHOICE

Our Department of Defense strives continuously to improve performance of men, machinery, and installations. For Otis Air Force Base, Therm-O-Tile was chosen by the Hartwell Co., East Providence, Rhode Island, as the underground conduit for the high pressure hot water heating system.

★ **EFFICIENCY**
Therm-O-Tile has been tested and proved to give high quality performance, with minimum heat loss.

★ **STRENGTH**
Controlled laboratory testing proved Therm-O-Tile stronger than standard or extra-strength tile.

★ **ECONOMY**
Therm-O-Tile offers double economy: 1. low initial cost; 2. low maintenance cost as piping failures within the conduit can be easily located and repaired.

Get complete details; write today:
H. W. Porter & Co., Inc., 825 Frelinghuysen Avenue, Newark 12, New Jersey or to the office nearest you.

Therm-O-Tile®
CONDUIT FOR UNDERGROUND PIPING

H. W. PORTER CO., INC. — NEWARK 12, NEW JERSEY
or Subsidiary
REID HAYDEN, INC.—BALTIMORE • CHARLOTTE • RICHMOND

WE HEAR THAT . . .

▸ *MIDLAND-ROSS CORP.* has acquired the *SURFACE COMBUSTION CORP.* No personnel changes are anticipated by Surface Combustion as a result of the merger.

▸ *SLANT/FIN RADIATOR CORP.* has completed an addition to its Richmond Hill, N. Y. facilities.

▸ *SCOVILL MFG. CO.* has installed a 2500 ton hot extrusion press in its Waterbury, Conn. plant.

▸ *FRICK CO.* of Philadelphia has been acquired by *GENERAL WATERWORKS CORP.* The Frick subsidiary will continue with the same staff and company name.

▸ *WALWORTH CO.* announced a licensing arrangement with *CANADA IRON FOUNDRIES, LTD.* for manufacture and sale in Canada of Walworth's industrial valve line.

▸ *DRAYER-HANSON DIV. NATIONAL-U. S. RADIATOR CORP.* will hold a regional sales convention in Dallas February 1-4. The convention will be held simultaneously with the 2nd S. W. Heating & Air-Conditioning Show, where Drayer-Hanson's theme will be its 50th anniversary.

▸ *KEFLEX MFG. DIV. of U. S. FLEXIBLE METALLIC TUBING CO.* has announced the acquisition of two factory buildings in San Francisco having a total area of 27,000 sq ft.

▸ *ROBERTSHAW-FULTON CONTROLS CO.* has moved its eastern research center into a new 17,000 sq ft building on the Schuylkill Expressway at King of Prussia, in suburban Philadelphia.

▸ Transfer of *COOLING TOWER INSTITUTE* offices from Palo Alto, Calif. to 1120 W. 43rd St., Houston, Texas has been announced.

▸ The merger between *EHRET MAGNESIA MFG. CO.* and *BALDWIN-HILL CO.* has been completed. The new company will be known as *BALDWIN-EHRET-HILL, INC.* with offices at 500 Breunig Ave., Trenton, N.J.

▸ *KEASBEY & MATTISON CO.* recently opened its new office building and research & development center

WE HEAR THAT

Continued

formally at Ambler, Pa. The new 20,000 sq ft office building is air conditioned throughout.

▸ *ILG ELECTRIC VENTILATING CO.* recently awarded prizes in a contest for industrial ventilating equipment buyers in which they were asked to answer these questions. What is the most unusual ventilating application you have ever seen or heard about? What unusual ventilation application would you like to see attempted? Judges in the contest were E. C. Kubecek, director of alumni relations and placement, Illinois Institute of Technology; John Maras, chief mechanical engineer, Graham, Anderson, Probst & White, Inc.; Robert Salinger, chief mechanical engineer, Naess & Murphy. Some answers included: keeping fog off low places on highways by using ventilating fans; using ventilating fans to segregate foreign matter, pine needles, etc., room cocoons of spruce worms in hibernation; hot air removal from parked cars in summer; underground exhaust fans at traffic intersections to capture automobile exhaust gases.

▸ *EVANITE PLASTIC CO.* has purchased a 30 acre industrial site in Leesburg, Fla. for construction of a plastic pipe plant. The plant is expected to be in operation by Feb. 1, 1960.

▸ *PEBBCO INDUSTRIES INC.* is the new name of *PENN BOILER AND BURNER MFG. CORP.*

▸ *REPUBLIC APPLIANCE CORP.* and *TRANS CONTINENTAL INDUSTRIES, INC.*, has merged.

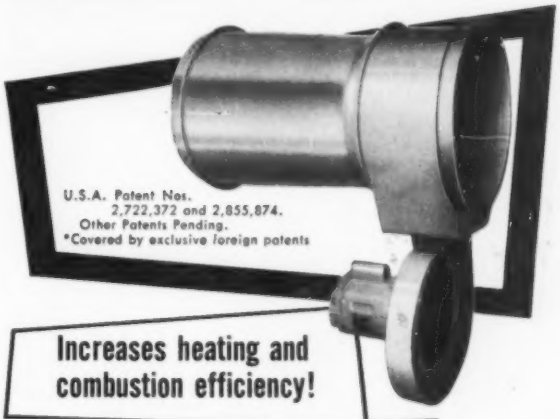
▸ *WESTON HYDRAULICS, LTD.* west coast subsidiary of *BORG-WARNER CORP.* has opened its 100,000 sq ft Van Nuys, California plant.

▸ *HOOKER CHEMICAL CORP.* has announced plans to move its corporate headquarters to 666 Fifth Ave. in New York City. The new offices will be ready for occupancy in late February or March 1960.

▸ *TRANE CO.* announced plans to build a new 60,000 sq ft plant in Salt Lake City, Utah.

▸ *SWARTWOUT CO.* is moving from Cleveland, O. to Kokomo, Ind. and will be known as the *SWARTWOUT FABRICATORS, INC.* G. V. Patterson, vice president of Swartwout will be president of the newly formed company.

Quickdraft... THE WORLD'S SAFEST POWER DRAFT UNIT FOR INDUSTRIAL, RESIDENTIAL AND INSTITUTIONAL EXHAUSTING



Increases heating and combustion efficiency!

Provides air power for bulk materials handling!

Exhausts corrosive gases and abrasives!

Quickdraft provides industry, commerce, institutions and homebuilders *power draft* engineered for economical and efficient combustion regardless of building or atmospheric conditions. Models suitable for every heating or incinerator application . . . eliminate pulsating or chattering, puffing, smoking and sooting. Reduce building costs, no tall, unsightly stacks required. Quickdraft also provides industry with ¼ inch to 60 inches W.G. static pressure for exhausting corrosive gases, abrasives and paint spray. Heavy-duty, high-pressure models, 6 inches to 30 inches diameter, are available for moving bulk materials or anything that can be moved by air. Because there are no motors, fans or bearings in exhaust line, only Quickdraft avoids costly clogging, corrosion of moving parts or fan failure.

IMPORTANT NOTICE

For withstanding corrosive gases, all Quickdraft units are available in standard acid resisting vitreous enamel, No. 316 Stainless Steel, rigid plastics (P.V.C.) and with plastic and Fiberglas coatings.

N-622-QD

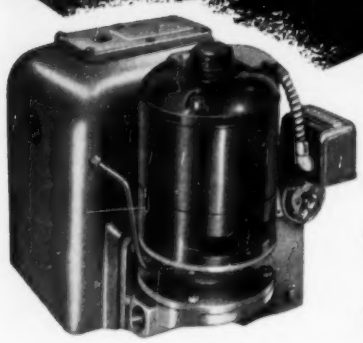
NO MOTORS FANS OR BEARINGS IN EXHAUST LINE

Send for QUICKDRAFT ENGINEERING DATA on your application . . . now.

Quickdraft CORPORATION

P.O. Box 87-K, Canton 1, Ohio

IT'S NEW! IT'S TOPS!
it's the *Sterlco* 4223-E
LOW PRESSURE
CONDENSATE PUMP



☆ SURPRISING VERSATILITY
☆ UNUSUAL CAPACITY
☆ TREMENDOUS PERFORMANCE
☆ ECONOMICAL PRICE

- **DESIGNED SPECIFICALLY FOR SMALL INSTALLATIONS . . .** yet adequate for jobs up to 3000 sq. ft. EDR.
- **ALLOWS ACCURATE ADJUSTMENT . . .** Float switch travel can be adjusted for a draw of from .7 to 3 gals. per pumping cycle for close adjustment to boiler requirements.
- **SMALLER IN SIZE, YET BIGGER IN USABLE VOLUME . . .** a truly believe-it-or-not design. Although the 5 gal. cast iron tank is one of the smallest, it has greater "draw" or usable volume than many pumps with larger tanks.
- **LOTS OF EXTRA CAPACITY FOR EMERGENCIES . . .** Equipped with the same pump and motor used for the larger capacity ¼ h.p. Sterlco pumps.
- **TAKES LESS SPACE THAN ANY OTHER . . .** Occupies only 1.6 sq. ft. of floor space. Fits easily into almost any small corner because of rectangular shape and convenient location of motor and switch at front of unit.
- **EXCEPTIONALLY QUIET, RUGGED, DEPENDABLE . . .** Includes the same high quality features found in Sterlco's heavy duty pumps.

USE THE RIGHT PUMP FOR THE JOB!

The addition of the No. 4223-E makes the Sterlco 4100-4200 Series Condensation Pumps one of the most complete lines of low pressure pumps on the market.

Write now for complete information.

Sterlco Products Distributed Through Leading Heating and Plumbing Wholesalers. Representatives in all principal cities.

STERLING, INC.
5202 W. Clinton Ave., Milwaukee 18, Wisconsin

CONDENSATION AND VACUUM PUMPS

HEATING SPECIALTIES

TEMPERATURE CONTROLS

WE HEAR THAT

Continued

▸ *MATHES CO.* presented its 1960 product line to dealers and distributors in its Fort Worth, Texas factory on October 30.

▸ *BALTIMORE AIRCOIL CO., INC.* held an open house at its manufacturing facilities for ASHRAE's Regional III meeting.

▸ *REVCOR, INC.* has begun an expansion program to add 28,000 sq ft of manufacturing space to their present plant. The program will be completed by December, 1959.

▸ *VALLEY IRON WORKS CO.* has become a wholly-owned subsidiary of the *ALLIS-CHALMERS MFG. CO.* It will be known as *VALLEY IRON WORKS CORP.*

▸ *PERFECTION INDUSTRIES* introduced its 1960 product line and merchandising program at a recent meeting held at the Tides Hotel, Redington Beach, Fla.

▸ *GENERAL CONTROLS CO.* executives have purchased the last 25 shares of stock in *RAL-CON PRODUCTS CO.*, organized as a part of the Junior Achievement program.

▸ The international business of *CARRIER CORP.* will now be conducted by its subsidiary, *CARRIER INTERNATIONAL, LTD.*

▸ *YOUNGSTOWN SHEET AND TUBE CO.* has announced plans for a five point major expansion program at its Indiana Harbor works.

▸ *MILWAUKEE VALVE CO.*, a subsidiary of *CONTROLS CO. OF AMERICA*, has sold its business and certain assets. The new management plans to continue present sales and manufacturing practices from the Milwaukee plant.

▸ *K S M PRODUCTS, INC.* has broken ground for a new plant and office facilities on a 12 acre tract in Moorestown, N. J. Occupancy of the new quarters is expected in the spring of 1960.

▸ *METREX VALVE CO.* has organized an eastern division with headquarters in Franklin Park, Illinois. The newly formed division will have North and South

WE HEAR THAT

Continued

Dakota, Nebraska, Kansas, Oklahoma, and Texas as its western boundry.

▸ *LAU BLOWER CO.* recently completed construction of a 35,000 cfm test tunnel at its Dayton, Ohio facility.

▸ *DEAN HILL PUMP CO., INC.* has changed its name to *DEAN HILL CORP.*

▸ *HOWELL ELECTRIC MOTORS CO.* has purchased the *LELAND ELECTRIC CO.*

▸ *PROTECTION CONTROLS, INC.* has completed building a new plant at 7317 N. Lawndale Ave., Skokie, Ill.

▸ *du VERRE INC.* has announced a program to increase its facilities to 20,000 sq ft.

▸ *TENNEY ENGINEERING, INC.* has received the 1959 Air Power Award from the New Jersey wing of the Air Force Association for designing, developing, and manufacturing a stratosphere chamber of such size "to take men and materials up 150 miles."

▸ *CRANE CO.* has been awarded three research contracts to develop valves for atomic reactors.

▸ The Education Committee of the *OIL HEAT INSTITUTE OF AMERICA* announced a film strip on combustion testing as being available. The film was prepared and produced by the *BACHARACH INDUSTRIAL INSTRUMENT CO.*

▸ The *VIRGINIA ELECTRIC AND POWER CO.* has received three canned motor pumps for use in a controlled-circulation boiler which will be installed in its Possum Point Station near Quantico, Va. Delivery of the 11,000 gpm pump units is scheduled for late 1961. The units operate at 1800 rpm and are designed to pump fluids up to 600 F at 3000 psi.

▸ *CHARLES R. HOOK* has resigned as chairman of the board of *ARMCO STEEL CORP.* Mr. Hook will continue as a director of the company.

▸ A new division of *FEE & MASON MFG. CO., INC.* has been established for the importation and American distribution of a line of pipe suspension products from West Germany. ⧺

Aerovent FANS

Checking specifications and comparing notes prior to "blast-off" of unit #3 at Astoria Generating Station, Long Island, New York.

built BIG for a BIG job at Con Edison

Inspecting three of a total of 24–84" Duct Fans recently installed at Consolidated Edison's new Arthur Kill and Astoria, New York Generating Stations are a member of Con Edison's Engineering Staff and D. J. Citron, New York area representative for Aerovent.

Twelve units, rated at 100,000 cfm each, provide a total of 1,200,000 cfm to draw heat from boiler plants in both locations. In addition, eight 32" Panel Fans, rated at 10,000 cfm each, cool turbine rooms at each station. That's cooling – KING SIZE!

Write for Bulletins 100 and 151

Air deliveries of Aerovent equipment determined in accordance with established and accepted codes and guaranteed by manufacturer.

CERTIFIED PERFORMANCE

Aerovent

FAN COMPANY, INC.

Ash and Branch Sts. Piqua, Ohio

Consolidated Edison's new Arthur Kill Generating Station situated at Staten Island, New York.

MEETINGS & CONVENTIONS

1959

DEC. 7-11—*Plumbing - Heating - Cooling Information Bureau* sales training course for instructors. Del Prado Hotel, Chicago. Information: Plumbing-Heating-Cooling Information Bureau. 35 E. Wacker Drive, Chicago 1.

DEC. 7-11—*4th Biennial Short Course in Corrosion Control.* University of Illinois, Urbana, Ill. Information: Supervisor of Engineering Extension, Illini Hall, Champaign, Ill.

DEC. 8-10—*Better Heating-Cooling Council* 4th annual meeting. Sheraton-East Hotel, New York City. Information: Better Heating-Cooling Council, 250 Park Ave., New York 17.

1960

JAN. 12-16—*Society of Plastics Engineers, Inc.*, 16th annual technical conference. Conrad Hilton Hotel, Chicago. Information: Society of Plastics Engineers, Inc., 65 Prospect St., Stamford, Conn.

JAN. 22-23—*National Association of Corrosion Engineers*, 5th annual corrosion control short course. University of Houston. Information: Course Chairman, M. A. Riodan, Rio Engineering Co., P. O. Box 6036, Houston 6.

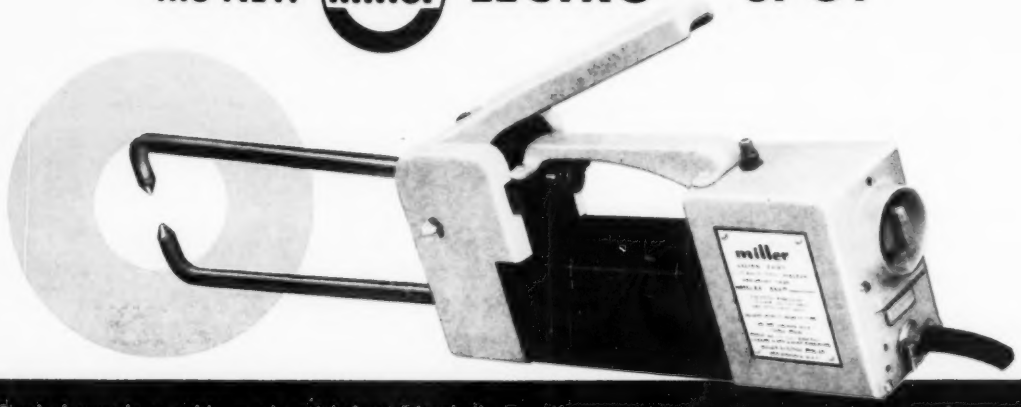
JAN. 25-28—1960 *National Plant Maintenance & Engineering Show and Conference.* Convention Hall, Philadelphia, Pa. Information: Clapp & Poliak, Inc., 341 Madison Ave., New York 17.

FEB. 1-4—*2nd Southwest Heating and Air Conditioning Exposition.* Dallas. Under auspices of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, in conjunction with the newly merged society's semi-annual meeting also in Dallas. Meetings to be held in the Baker and Adolphus Hotels; exposition to be held in Memorial Auditorium. Information: International Exposition Co., 480 Lexington Ave., New York 17. ASHRAE headquarters: 62 Worth St., New York 13.

FEB. 2-4—*Society of the Plastics Industry, Inc.*, 15th SPI Reinforced Plastics Division Conference. Edgewater Beach Hotel, Chicago. Information: Society of the Plastics Industry, Inc., 250 Park Ave., New York 17.

Hottest "Spot" in the Shop

the NEW miller LECTRO SPOT



Simply depress lever and tongs grip metal at pre-determined pressure, switch is turned on and weld sequence timer is actuated for precise period set on control dial. Thus, every weld is identical until timer adjustment is changed. Pilot light indicates when welder is connected.

This advanced design plus light weight and wide selection of tongs make the new Miller Lectro Spot the finest welder of its type.

Available in three styles: 115v or 230v, 1.5 KVA models for work to 1/8" thickness, both weigh 29 lbs.; 230v, 2.5 KVA model for mild steel to 5/32", weighs 37 lbs.

Complete specifications with tong and tip availabilities will be sent promptly upon request.

miller ELECTRIC MANUFACTURING COMPANY, INC. • Appleton, Wisconsin

Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal

MEETINGS & CONVENTIONS

Continued

FEB. 1-5—*Instrument Society of America,* instrument-automation conference and exhibit. Houston Coliseum. Information: William H. Kushnick, Executive Director, Instrument Society of America, 313 6th Ave., Pittsburgh 22.

MARCH 14-18—*National Association of Corrosion Engineers,* annual conference and corrosion show. Dallas Memorial Auditorium, Information: National Association of Corrosion Engineers, 1061 M & M Bldg., Houston 2.

MARCH 21-24—*2nd Annual Industrial Ventilation Conference.* North Carolina State School of Engineering, Raleigh, N. C. Conducted by Dept. of Mechanical Engineering of School of Engineering and College Extension Division; sponsored by Occupational Health Section of North Carolina State Board of Health. Information: College Extension Div., P. O. Box 5125 State College, Raleigh, N. C.

MARCH 29-31—*22nd Annual American Power Conference.* Hotel Sherman, Chicago. Information: Conference Director, R. A. Budenholzer, Mechanical Engineering Dept., Illinois Institute of Technology, 3300 Federal St., Chicago 16.

APRIL 4-7—1960 *Nuclear Congress and International Atomic Exposition.* New York Coliseum, New York City. Information: International Atomic Exposition, 117 S. 17th St., Philadelphia 3, Pa.

APRIL 4-7—*Oil Heat Institute of America, Convention and Exposition.* Convention: Park-Sheraton Hotel, New York, Exposition: Coliseum, New York. Information: Oil Heat Institute of America, Inc., 500 5th Ave., New York 36.

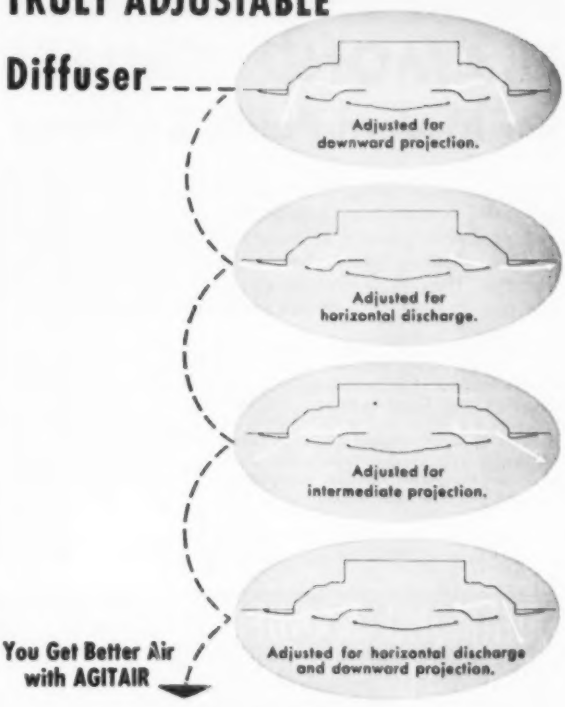
APRIL 25-29—*American Welding Society,* annual meeting and exposition. Los Angeles. Information: American Welding Society, 33 W. 39th St., New York 18.

APRIL 27-30—*Western Air Conditioning, Heating Ventilating and Refrigeration Exhibit and Conference.* Shrine Exposition Hall, Los Angeles. Information: Western Air Conditioning Industries Association, 3443 S. Hill St., Los Angeles 7.

Take a look at a

TRULY ADJUSTABLE

Diffuser


Adjusted for downward projection.
Adjusted for horizontal discharge.
Adjusted for intermediate projection.
Adjusted for horizontal discharge and downward projection.
You Get Better Air with AGITAIR

AGITAIR®

TYPE "OA"

Here's a distinctively different diffuser with a radically new means of controlling air direction at four different angles of discharge simultaneously. *Without changing the position of the spinnings,* AGITAIR "OA" diffusers can be adjusted to put the air where you want it in one, two, three or four directions . . . *after installation.* Result: Segmentized . . . positive adjustability with Finger-Tip Air Direction Control.

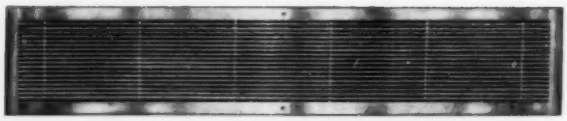
Write for Bulletin C-101

Contains complete data, performance charts, construction details, etc.

AIR DEVICES INC.

185 MADISON AVENUE, NEW YORK 16, N. Y.

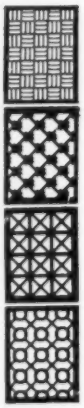
AIR DIFFUSERS • FILTERS • EXHAUSTERS



DIAMOND GRILLES

For Modern Public Buildings

When you need grilles that retain their original attractive appearance indefinitely — against any probable amount of rough treatment — you'll be starting right by sending for our latest bulletins. They show designs developed during nearly half a century of successful experience.



Bulletin 41 illustrates and describes Diamond Architectural Grilles; stamped from any commercial metal in a wide variety of artistic designs; in any desired thickness up to one-fourth inch.

Bulletin 43 illustrates and describes Diamond Fabricated Grilles; heavy-duty bar-type grilles designed and built to give the best possible combination of enduring strength and high open area.

Both bulletins will be mailed promptly on request without charge or obligation

DIAMOND MANUFACTURING CO.
Box 40 WYOMING (Wilkes-Barre Area). PENNA.

Dependable Accuracy . . .
with TRERICE
DIAL THERMOMETERS

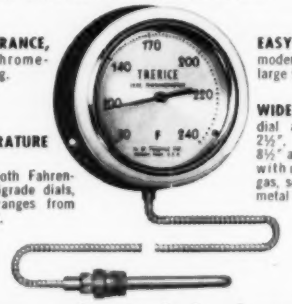
If you are after precise, dependable temperature indication, take a close look at these high-quality features of Trerice dial thermometers!

NEAT APPEARANCE, distinctive chrome-plated dial ring.

EASY TO READ, modern aluminum dial, large figures.

WIDE VARIETY, dial available in 2", 2½", 3½", 4½", 6", 8½" and 12" diameters with mercury, vapor, gas, solid liquid or bi-metal actuation.

WIDE TEMPERATURE RANGES, available in both Fahrenheit and Centigrade dials, temperature ranges from -100° to 1000° F.



All the many other standard and special option features of Trerice dial thermometers are contained in Bulletin No. 500-M. Write for your copy.

Send Bulletin 500-M.

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H.O. TRERICE CO. 1420-C W. Lafayette Blvd. Detroit 16, Michigan

MEETINGS & CONVENTIONS

Continued

JULY 25-29—*13th International Congress on Occupational Health.* Waldorf-Astoria Hotel, New York. Information: Dr. Leo Wade, 15 W. 51st St., New York.

NOV. 28-*DEC.* 2—*24th National Exposition of Power and Mechanical Engineering.* Under auspices of the American Society of Mechanical Engineers. New York Coliseum. Information: International Exposition Co., Inc., 480 Lexington Ave., New York 17.

Obituaries

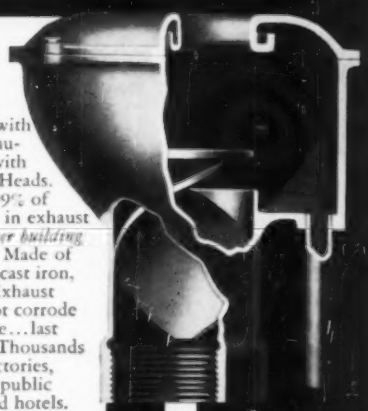
Julian Nardi

Julian Nardi, 62, chief mechanical engineer of Ford, Bacon & Davis, Inc., New York engineering and management consultants, was among 26 persons who died in a Piedmont Airlines plane crash in Virginia on October 30. Mr. Nardi began his career as a draftsman with Sargent & Lundy, Inc., Chicago, and in 1922 moved to Stone & Webster, Inc., Boston, where he rose from draftsman to senior mechanical engineer. From 1931 to 1932, he was engineer in charge at Stuart, James & Cooke, Inc., New York, and after a number of assignments in private practice as a consulting engineer, he joined Ford, Bacon & Davis in 1935. He became chief mechanical engineer of the firm in 1935.

Henning W. Prentis, Jr.

Henning W. Prentis, Jr., 75, chairman of the board of Armstrong Cork Co. since 1950 died recently in Lancaster, Pa. Mr. Prentis joined the company in 1907 as assistant to the manager of the insulation division. Four years later he became the first manager of the newly formed advertising department and, in 1920 was appointed general sales manager of Armstrong's floor division. In 1926 he was elected vice president of the company and a member of the board of directors. Three years later he became first vice president and, in 1934, he was elected president where he served until his retirement in 1950.

Swartwout
EXHAUST HEADS
slash building maintenance cost



Prevent the ravages of water and oil in exhaust steam during warm weather...do away with ice and grime accumulations in winter—with Swartwout Exhaust Heads. They remove over 99% of moisture and oil in exhaust steam—*for lower building maintenance.* Made of long-lasting cast iron, Swartwout Exhaust Heads do not corrode or deteriorate...last indefinitely. Thousands in use on factories, institutions, public buildings and hotels. Many still in use even after *50 years continuous service.*

Available from your industrial distributor or from The Swartwout Company. For exhaust pipes from 1 to 30" in diameter. Write for free Bulletin S-16-C.

Cutaway section shows exclusive helica-centrifugal principle that prevents back pressure. Swartwout Exhaust Heads blend in with modern or classic architecture, actually enhance building appearance.

The Swartwout Company
18511 EUCLID AVE. • CLEVELAND 12, OHIO

"Seals tight...FAST!"

Cut assembly time with **KEY-TITE®**, the tight sealing waterproof pipe joint compound. It's ideal for water, gas, and low pressure lines—safe for potable liquids—contains no toxic ingredients. Actually lubricates while it seals—joints don't freeze.

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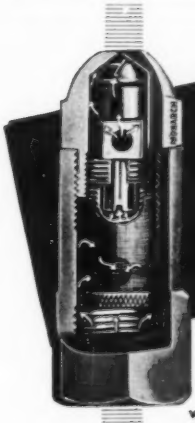

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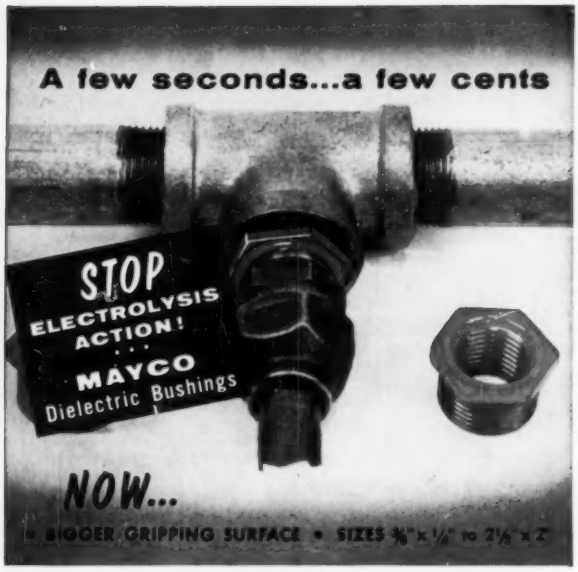

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NEW BOOKS & REPORTS...

Vocational and Professional Monographs (Engineering), by Edward H. Robie. 36 pp. Bellman Publishing Co., Post Office Box 172, Cambridge 38, Mass. $1.00

AWS Soldering Manual, 176 pp. American Welding Society, Dept. 1, 33 W. 39th St., New York 18. $5.00

Bibliography on Combustion-driven Oscillations, edited by Abbott Putnam and Carl Speich. Battelle Memorial Institute, Columbus 1, Ohio.

Plastics Safety Handbook, by Society of Plastics Industry, Inc. in cooperation with National Safety Council. Society of the Plastics Industry, Inc., 250 Park Ave., New York 17. $5.00

National Electrical Code (1959 edition), by National Electrical Manufacturers Association. 155 E. 44th St., New York 17. 50c

Cermets, 1940-59 *CTR*-319, and *Rust Prevention and Removal CTR*-305, by Office of Technical Service, U. S. Dept. of Commerce, Washington 25, D. C. 10c each.

Dial Arrangement of Warm Air Limit and Fan Controls DE-4-1959. National Electrical Manufacturers Association, 155 E. 44th St., New York 17. 20c.

National Fire Codes, 1959, six volumes. 5280 pp. National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass. $7.00 per volume, $35.00 for six volumes. ≠

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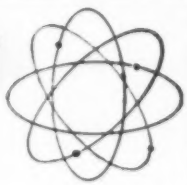

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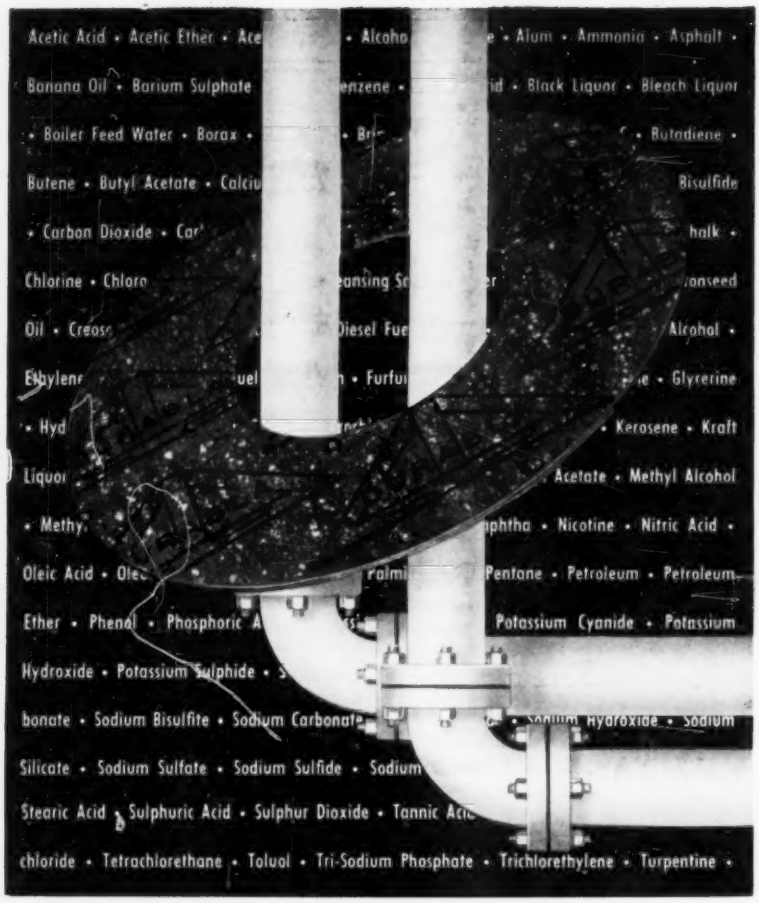
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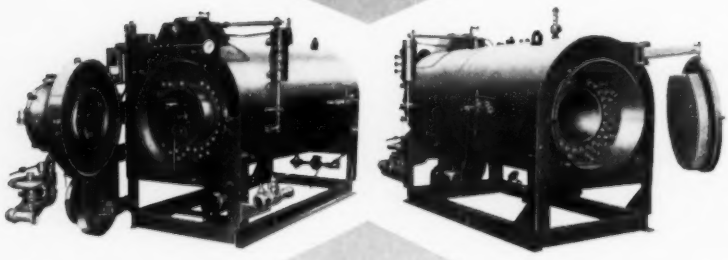

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20 to 600 HP steam boilers—to 250 psi
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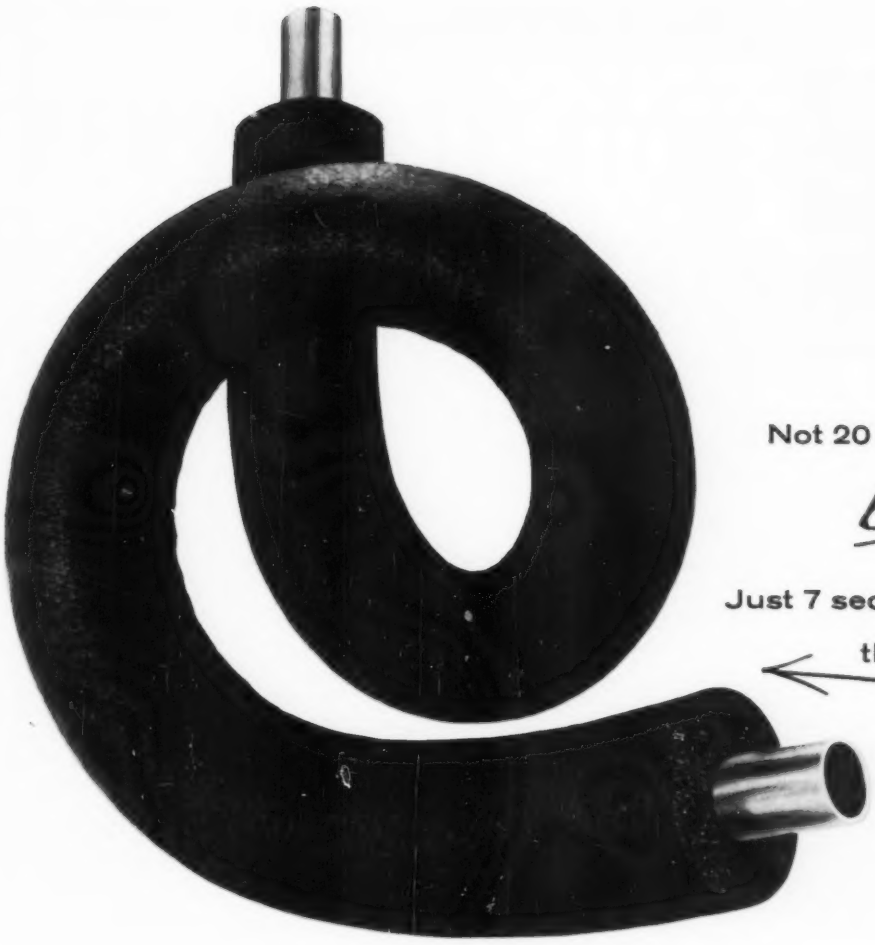

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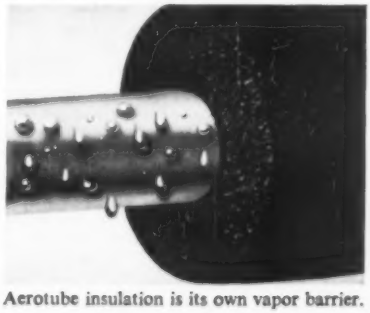

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8 BABBITT SQUARE, NEW BEDFORD, MASS., U.S.A.

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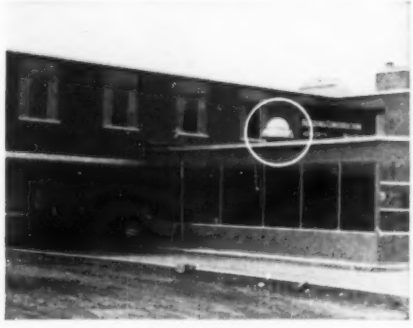
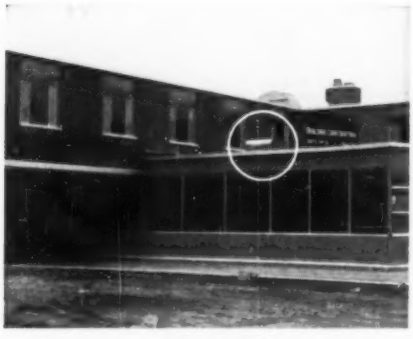


BEFORE

These before and after job photographs illustrate how Penn's LC Dynafan reduces roof exhauster heights and protects your job appearance.



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On this job competitive units were installed and replaced by LC Dynafans. Protect your finished job appearance at the time of design—Specify LC Dynafans.

Cuts 50% off normal roof exhauster heights

Gives greater stability, better balance, eliminates vibration

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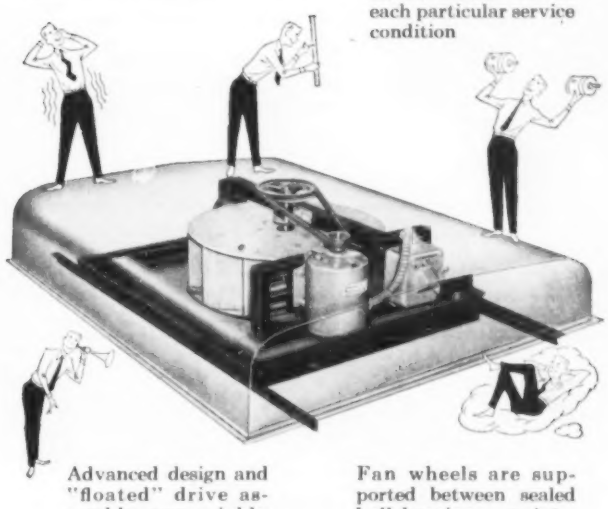

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Fan wheels are supported between sealed ball bearings—maintenance is minimized

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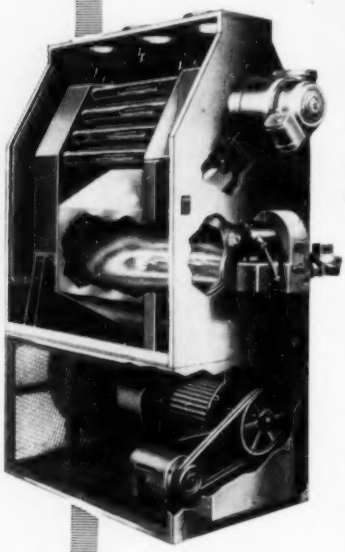

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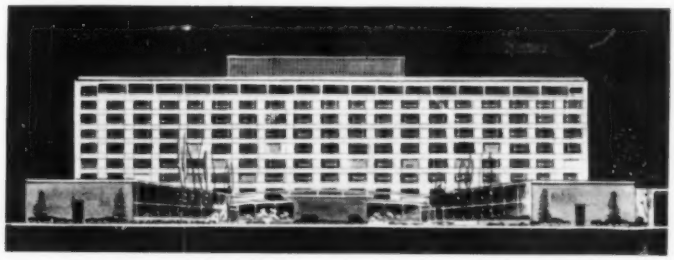

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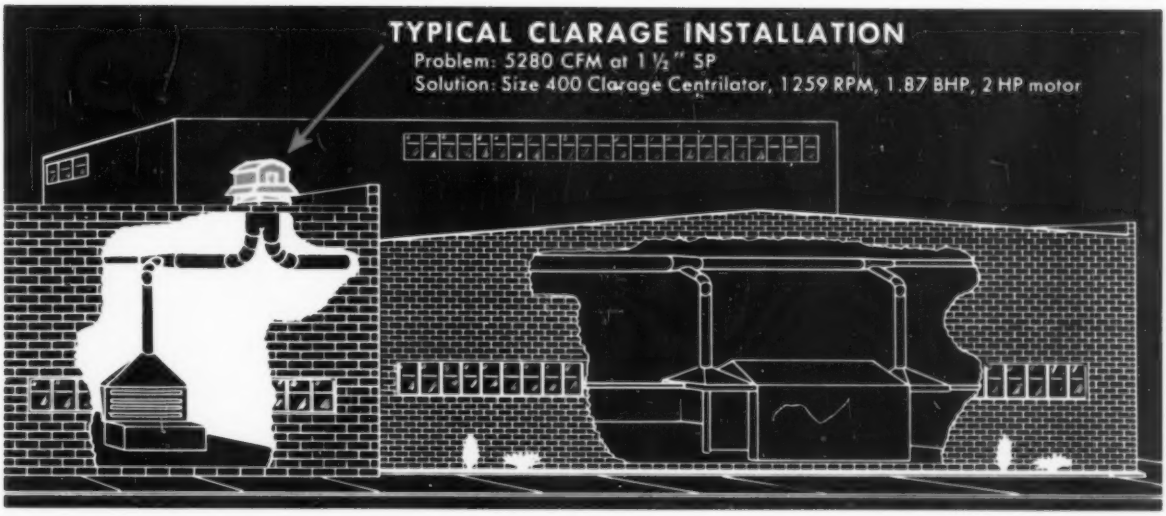
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230-1 IN.-30	743,400	30 lbs.	1"	1"
240-1 IN.-30	910,000	30 lbs.	1"	1¼"
230-1½ IN.-30	1,025,100	30 lbs.	1½"	1½"
240-1½ IN.-30	1,560,000	30 lbs.	1½"	2"
240M-3	2,313,000	30 lbs. 36 lbs.	2"	1" 2"
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